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CURTIS E. WHITTLESEY, Secretary and Treasurer.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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THE IOWA CONVENTION.

The Iowa Electrical Association usually manages to crowd much profitable discussion into a two days' convention; its program usually not being overloaded with long papers that sacrifice the opportunities for discussion. This year one of the notable features of the recent meeting was a discussion on the subject of grounding. A committee on that subject made a report on some tests which are in progress on the relative efficiency of different kinds of grounds. The tests in general showed that in Iowa soil, which is usually damp to within 3 ft. or 4 ft. of the surface, a 1½-in. galvanized iron pipe, driven 10 ft. into the ground, is better than any kind of plate a foot square. The tests also showed consistently a higher resistance for plates in charcoal as compared with plates in plain earth, thus contradicting the usually accepted opinion to the contrary. During the meeting, Prof. L. B. Spinney presented in a forcible way the necessity for good voltage regulation. Few small companies explore the conditions of voltage regulation on their lines as they should. Usually this is considered merely as to its effect on the lamp life. This is the least of its evils, for a few per cent variation in voltage means a large percentage in candle-power; and while the consumer never objects to increase in candle-power, a decrease must be very gradual not to raise a protest. Fluctuations are thus sure to make trouble, and there are very few small central-station systems on which the voltage regulation does not need more attention than it gets. It seems to be the prevalent opinion that a public-service commission law will be brought up at the next Iowa Legislature as a live issue, and an address on the subject by one of the Iowa legislators who has been active in urging such a law was one of the features of the convention. Rates received a considerable share of attention, and commission decisions which were summarized by one of the speakers showed a notable uniformity as to the method of treatment of the rate problem. It was also gratifying to learn of considerable success being attained in one manufacturing town in getting factories taking electric energy to work during such hours as avoid the station peak load and thus to secure a low non-peak rate.

THE ELECTRICAL PRODUCTION AND TRANSMISSION OF MUSIC.

A record of marked progress in the design and construction of apparatus for the electrical production and transmission of music is given in this issue in an article descriptive of the Cahill telharmonic system. It will be recalled that the method employed by Dr. Cahill consists in generating alternating currents of proper frequency and amplitude to be superposed in such a maner that a telephone diaphragm subjected to their magnetizing effect will produce any desired musical sound. The first equipment constructed for the purpose showed that electrically produced music could be made very sweet, but indicated that an elaborate generating and controlling installation would be required for the best effects. In the second

equipment, which was placed in service for a time in New York City, many of the limitations of the initial installation were overcome and the possibility of producing excellent music was proved. However, the controlling equipment, as manipulated by the performers, was so complicated that no trained musician could be induced to devote to it the years of study and practice necessary to master it properly. It was not surprising, therefore, that the music produced by the New York Telharmonium was considered imperfect by many musicians.

In the third and latest equipment several important changes have been introduced, and the musical effects have been improved correspondingly. As is frequently the case in the development of an invention, the changes have resulted simultaneously in a simplification of the installation and a lessening of the cost of construction. The present Telharmonium is devoid of those complications at the keyboard which discouraged the accomplished piano or pipe-organ player from attempting to master the instrument; and the effect which such a musician can produce with the latest equipment after a practice of a few days is enormously superior to any effect which would have been obtainable by any one after a lifetime of study and practice with the New York Telharmonium plant. Doubtless additional improvements will be made in the present or future Telharmoniums before the development of electrical music has been completed, but enormous progress has already been made as shown by a comparison of the third with the first equipment built by the inventor.

THE EXCITATION OF INDUCTION MOTORS.

In practically only one of its characteristics can the induction motor be considered inferior to the synchronous motor, namely, in the lower power-factor at which it operates by reason of the fact that so-called wattless current for its excitation must be transmitted over the alternating-current supply lines. It should be noted, in passing, that it is superior to the synchronous motor in that it does not require a special generator for the supply of exciting current. As is true of both types of motor, a definite amount of field magnetism is necessary for providing each value of counter e.m.f. In the synchronous motor, the major portion of the m.m.f. for the required field magnetism is supplied by current from a special generator, while only a small plus or minus quantity is produced by lagging or leading wattless alternating current. In the induction motor as usually constructed, all of the exciting m.m.f. appears as lagging wattless current in the primary windings. However, it is possible for current in the secondary to produce the m.m.f. for excitation, and certain advantages may at times be obtained by thus exciting the machine. The value of ampere-turns for excitation is the same whether existing in the primary or the secondary winding, but the values of the volt-amperes are quite different in the two cases. Neglecting the copper loss incidental to the presence of the current it may be said that the value of the wattless volt-amperes for secondary excitation bears to the amount for primary excitation the ratio of the secondary to the primary frequency, or the ratio of slip to the synchronous speed. When the slip is zero, no wattless volt-amperes are required and direct-current can be employed equally as well with an induction motor as with a synchronous motor. In any event, under running conditions the wattless exciting volt-amperes will be materially less when supplied to the secondary rather than to the primary circuit.

Among the schemes that have been proposed for exciting an induction motor by way of its secondary circuit mention should be made of the one involving the direct application of the full-frequency current to a revolving commutator to which the secondary rotor conductors are connected. Evidently the proper secondary frequency is produced automatically at all values of the slip, while any desired time-phase position of the exciting m.m.f. can be obtained by mechanically shifting the brushes to the proper position on the commutator. When the slip increases with the increase in load, the e.m.f. required to produce a constant value of exciting ampere-turns in the secondary increases also, and the brushes must be shifted to maintain a constant relative position of the secondary exciting m.m.f. To these changes and the involved complications may be attributed the fact that the above-mentioned scheme has not been applied in general practice.

The Digest in the present issue contains an outline of a special generator designed by Mr. Miles Walker for supplying exciting current of the proper frequency directly to the secondary windings of an induction motor. The exciter is a commutator-type generator so arranged as to receive its own exciting current from the secondary of the induction motor; it delivers to the secondary circuit, or adds to the e.m.f. across the secondary terminals, an e.m.f. of the secondary frequency varying in value with the product of the secondary current and the rotative speed. Doubtless the machine can be adjusted to supply secondary m.m.f. of any desired value and relative time-phase for any chosen load on the motor, and probably it can be arranged to maintain the proper excitation with change in the load, or vary the excitation with the load as may be desired. In whatever form the motor and exciter may be constructed, the equipment would seem to be superior to the synchronous motor with its exciter, but inferior to the induction motor from the viewpoint of simplicity. Experience alone can show to what extent the complications added by it to the simple-induction motor are counterbalanced by the advantageous decrease in the lagging wattless current taken by the machine.

PLATINUM-IRIDIUM HOT-WIRE AMMETERS AND VOLTMETERS.

A hot-wire voltmeter was the earliest form of switchboard voltmeter for use on alternating-current circuits. This was the Cardew voltmeter. It consisted essentially of a tube containing some 4 m of fine platinum wire in two loops. The ends of this length of fine wire were connected to a pair of terminals receiving the full main pressure of, say, 120 volts. The heating of the wire by the current, under the impressed e.m.f., expanded and lengthened the wire slightly, while a pointer, moving over a nearly uniform scale of volts, indicated by means of this expansion. The Cardew voltmeter was for some years the most generally used switchboard alternating-current voltmeter, but finally gave way before smaller and more compact instruments of lesser temperature error. After some time a new form of hot-wire instrument made its appearance on switchboards, for current as well as for voltage. In this form, a short length of wire was used, but its expansion under load was magnified considerably before being delivered to the pointer wheel. These instruments were dead-beat; in fact, they were apt to be rather sluggish, a quality sometimes advanta-

geous in switchboard work. Their principal objection has been temperature error. They have to work with their wires well below red heat, and then any incidental charge of, say, 20 deg. C. in their surroundings was likely to affect their readings very distinctly. A recent number of the *Elektrotechnische Zeitschrift,* as alluded to in the Digest, describes an improved form of these hot-wire instruments. Platinum-iridium is the substance employed for the fine wires and their working temperature is raised. At the same time, the base of the instrument is of such metals as enables a compensation for external temperatures to be automatically maintained.

RESEARCHES ON LIFTING ELECTROMAGNETS.

Electromagnetic solenoids and traction magnets are used in a variety of industrial applications. Large electromagnets are sometimes used for picking up and carrying sheets of steel, or pigs of iron, in factories. Electromagnetic feet are sometimes applied to drilling machines in shipbuilding yards. The magnets cling like limpets to the steel decks of the vessel and allow the tool to be forcibly directed against the work. Switches and contactors, in great variety, are operated by electromagnetic solenoids. The design of these devices is a special branch of electrical engineering work. The fundamental laws of the electromagnetic forces utilized in traction magnets are fairly well understood, but, in detail, there is still room for much technical progress, because there are so many factors which enter into the action. The ampere-turns, the size, weight and cost of the winding, the electric power expended, the temperature elevation, the maintenance of good insulation, the length of stroke, the magnetic quality of the iron in the magnetic circuit, the shapes of the opposed attracting surfaces, the magnetic leakage and remanence, as well as a variety of other considerations, all enter into and affect the design. Researches into the influence of some of these factors are always welcome. A particular branch of this research is alluded to, this week, in the Digest, as reported by Professors Berninger and Edler, in the *Elektrotechnik und Maschinenbau.*

THE FLAMING ARC IN STREET LIGHTING.

We publish elsewhere in our columns a most instructive article by Mr. Francis Jehl, engineer of the Budapest General Electric Company, on the results attained in that city with street lighting by flame arcs. Budapest has been for years a city lighted strictly by gas, and upon the whole rather well lighted. Electric street lamps were unknown until about a year ago, when, through the enterprise of the Budapest General Electric Company, an excellent flame-arc system was installed in some of the principal streets, as an example of first-class modern practice. The present paper deals with the experimental study of the illumination on the chief streets so lighted with reference to the results obtained, both photometrically and commercially. The method adopted was to determine the light distribution on the street by means of a Weber photometer, using a tungsten lamp operated from a storage battery as the reference standard. One or two technical points in the work are worth mentioning. The standard lamp was regulated by an ammeter, which has proved a good deal more reliable than trying to adjust it by means of a voltmeter. Also, the diffusion plate employed was of a kind which has been found by the Siemens Company particularly free from specular reflection, consisting of a plane surface of plaster of paris coated with magnesium oxide.

The height of the test plate from the ground was fixed at 1 m and the horizontal intensities were measured at this level. It is a little difficult to specify the proper height for such measurements. The main requirement is uniformity of practice, since it is necessary when making measurements on a horizontal plane to get this plane at a convenient height above the ground for operative reasons. In principle the test plate should be on the surface, but this is impracticable on account of shadows and the interference of bystanders. The arc lamps tested were Siemens-Schuckert arcs, taking 15 amp and burned three in series on 110-volt circuits. The electrodes were of the Alba type in the usual vertical arrangement. These lamps are hung 9.1 m above the pavement and spaced about 50 m apart on each side of the street. Each lamp consumes 550 watts and is screened by a thin diffusing globe, as is the universal practice abroad. The results obtained are of much interest. The flame arcs as described gave a mean horizontal illumination on the street of 8.5 luxes with a minimum of about 2.5. If one casually compares this illumination with that found on almost any American street, the result is something shocking. The maximum illumination ranged a little above 20. Obviously in a street so lighted one could read a newspaper practically anywhere.

An instructive modification was obtained by lowering the lamps from 9.1 m to 8 m, everything else remaining unchanged. The effect of lowering the lamps was to reduce the illumination seriously, the mean horizontal intensity dropping to 5.9 and the minimum to 2. Clearly the change of height was a very damaging factor in the results, even though the height in the unfavorable condition was still 25 ft. above the pavement. Had the lamps been lowered to the height customary in most American cities, the result can easily be imagined. As a comparison test, a section of the street lighted with gas lamps was also measured. These lamps were erected to compete with the flame arcs, each post having 15 inverted Welsbach burners. The height of the lamps from the street was about 5 m, and the 15 burners consumed 1725 liters of gas per hour. The photometric tests showed that so far as mean intensity is concerned, these great groups of gas lamps did their work, but in other respects they were somewhat at a disadvantage. The mean horizontal intensity was about 9.8 luxes, but with a minimum of 1.6 and a maximum of 84. In other words, the distribution was greatly inferior to that obtained from the arc lamps, a condition perhaps in part due to the insufficient height of the posts. Reducing the costs of lighting by these gas lamps and by the electric arcs to the same basis of cost per lux and per 100 sq. m of area, and taking gas at cost, the tests showed that under these conditions of intensity and distribution the flame arcs beat out the gas by about 44 per cent in cost, a result which is in very good accordance with comparisons made between flame arcs and modern gas lighting elsewhere, at least under conditions where high intensity of illumination is required. The experiments certainly show that for economical and brilliant lighting the flame arc presents unique advantages, and is so economical that it can more than hold its own against even cheap gas lavishly employed. Our thanks are due to Messrs. de Fodor and Jehl, of the Budapest Company, not only for their enterprise in breaking into a gas stronghold so effectively, but for their public spirit in reporting these very valuable tests.

San Francisco Meeting of the A. I. E. E.

Many side trips of special interest to electrical engineers have been arranged for in connection with the San Francisco meeting of the American Institute of Electrical Engineers to be held on May 5, 6 and 7. In San Francisco visitors will be given an opportunity for making sight-seeing trips around the bay, which will include visits to the local generating stations. The Pacific Gas & Electric Company has arranged for a tour of inspection of several of its mountain plants, and will provide special transportation and entertainment for those making the trip. The party will leave San Francisco on the evening of May 8 and in the course of the tour will make a side trip to the Big Bend plant of the Great Western Power Company, as guests of the latter company. The entire trip will require four days. Arrangements have also been made for members who visit Seattle, Portland and Los Angeles to be accorded the privileges of inspecting electrical plants in these cities.

At the formal meetings to be held in the auditorium of the Home Telephone Company, the following papers will be presented: "Emergency Generating Service in Connection with Hydroelectric Transmission Plants Under Pacific Coast Conditions," by Mr. A. M. Hunt; "Hydroelectric Power as Applied to Irrigation," by Mr. John Coffee Hays; "The Developed High-Tension Network of a General Power System," by Mr. Paul M. Downing; "Parallel Operation of Three-Phase Generators with Their Neutrals Interconnected," by Mr. George I. Rhodes; "Observations of Harmonics in Current and in Potential Wave Shapes of Transformers," by Mr. John J. Frank, and "Transmission Line Crossings of Railroad Right-of-Way," by Mr. Allen H. Babcock.

Maryland Public Utilities Commission.

Governor Austin L. Crother last week appointed the members of the Maryland Public Utilities Commission, as follows: Judge James Alfred Pearce, chairman, a resident of Kent County, and Messrs. W. W. Abell and James M. Ambler, of Baltimore. Judge Pearce having declined the appointment, Mr. Ambler was then designated as the chairman of the commission, and Mr. Phillip D. Laird, of Rockville, was appointed the third member.

Mr. James M. Ambler, the chairman of the commission, is a member of the law firm of Barton, Wilmer, Ambler & Stewart, and a native of Virginia. He came to Baltimore when a boy and rose from an office boy for a lawyer to membership in the firm with which he is now associated, and soon came to be recognized as a lawyer of ability and a man of the highest character. He is about 50 years old. Mr. Walter W. Abell is the son of the late Edwin Abell, the publisher of the *Baltimore Sun*. Mr. Abell managed this property until about a year ago when he retired and went abroad. He is at present traveling in Europe, and while nothing has been heard from him regarding his appointment, it is supposed that he will accept it. Mr. Abell is about 40 years old. Mr. Phillip D. Laird, of Rockville, is an official of the Farmers' Banking and Trust Company, of that place, and is regarded as being the only man of moderate means on the commission. Some years ago he inherited, by the death of a relative, $3,500, and his townsmen estimate his worldly goods at about $10,000. At Annapolis, when he served in the House of Delegates, he was frequently referred to as "poor but straight as a string."

In announcing the appointments, the Governor said he had endeavored to select the very highest type of men in the State, and who are not only not in politics, but have no political ambitions of any sort. He had not asked any one of them whether he will serve on the commission or not, taking it for granted that no public-spirited man in Maryland will decline to accept appointment on the Public Service Commission when he realizes the service that he can render to the people of the whole State. As most of the public service corporations are located in Baltimore the Governor, at the beginning, decided that two Baltimoreans should be named on the commission. But when Judge Pearce declined to accept, a county man was asked to serve, because this one man was thought to be the best candidate for the position. As the work of the commission will involve the handling of many intricate legal questions, the Governor deemed it advisable to put at least one lawyer on the commission, irrespectivve of the fact that the commission will have a chief counsel and other legal assistants. Mr. Ambler, the chairman of the commission, has been prominently spoken of for a judicial appointment, being highly endorsed for the appointment by a number of leading lawyers of Baltimore. He is regarded as being one of the best equity lawyers in the State. While all three of the commissioners are Democrats, they have never been active in the affairs of the party. The Governor is being commended because he did not confer with his proposed appointees before making his announcement.

Mr. Ambler was named for a term of six years, from May 1, 1910, when the active duties of his office begin. As the chairman of the commission Mr. Ambler is entitled to a salary of $6,000 a year, while his associates will receive $5,000. Walter W. Abell was named for the four-year term, and Phillip D. Laird for a term of two years. Hereafter all members of the commission will be named for the full term of six years unless it should be declared unconstitutional to appoint them for longer periods than two years, as some of the members of the legal profession have contended. Before the commission gets down to active work it will be necessary for Governor Crothers to select counsel for it. The chief counsel names his assistant, the Governor exercising the veto power, and the commission names its secretary.

Within the next few days a number of prominent lawyers representing different public-service corporations operating in Maryland will confer with a view of devising a plan for testing the constitutionality of the Public Utilities Bill. Former Attorney-General William S. Brayan, who has been invited to the conference, regards the bill as being unconstitutional. Representatives of corporations have advanced several propositions upon which they say that the constitutionality of the bill could be tested. The State Constitution, they point out, provides that no official, except those whose salaries are fixed in the Constitution, shall receive over $3,000 a year. The bill, they also contend, violates the Constitution in providing that the commissioners shall be appointed for six-year terms. The Constitution states that all appointments made by the Governor shall be for two years only. Some lawyers also claim that the bill is defective as the title does not clearly define everything contained in the bill. The title, they hold, declares that the measure is for the purpose of regulating corporations, and yet the bill provides for the regulation of public-service enterprises which are operated by one individual. It is expected that other legal objections will be raised at the coming conference. Attorney-General Isaac Lobe Straus, who drafted the bill, states that he went into all of these questions before the bill was introduced into the Legislature. The opinions of a number of other well-known lawyers have been gotten and they hold that the bill is constitutional.

New York Long Acre Lighting Company Wins on Appeal.

The Appellate Division of the Supreme Court, New York City, decided on April 22 that the New York City Public Service Commission exceeded its powers when it denied the application by the Long Acre Electric Light & Power Company for permission to issue $10,000,000 preferred stock and $50,000,000 of bonds to be secured by a mortgage on all its property, with $12,000,000 of bonds to be issued at once. Justice Scott wrote the prevailing opinion, and he was supported by Justices Clarke and Dowling. Presiding Justice Ingraham held that the application was denied properly and Justice McLaughlin voted with him.

The Long Acre Electric Light & Power Company was in-

corporated in 1903 and by its charter was authorized to generate and distribute electricity for all purposes in Manhattan and the Bronx. In 1906 it acquired a secondary franchise for such purposes as had been granted in 1887 to the American Electric Manufacturing Company.

When the Long Acre company applied to the Public Service Commission for the bond issue the commission denied the application on the following grounds: No certificate to begin construction had been obtained from the commission or its predecessor, the Commission of Gas and Electricity; it was probable that the bonds already issued were illegal and there was grave doubt of the legality of the stock having been approved by the Commission of Gas and Electricity; it was doubtful whether the title to the franchise was perfect; if the bonds already issued were illegal the approval of the application would authorize the capitalization of a franchise contrary to law; the amount of bonds was much too large as compared with the amount of voting stock; the construction contract did not protect adequately the interests of the company or the public; the applicant had not proved that existing companies were not properly conserving the public convenience and that it would be of advantage to the community to have a new company; if it got permission to operate it was not likely to operate independently for any considerable period; competition would cause inconvenience and expense to the public and duplication of plants, and finally, practically all the advantages claimed by the applicant as to the probable results of competition could be secured through the powers of the Public Service Commission.

As to these various reasons for rejecting the application Justice Scott held that the first reason was untenable because the franchise had been exercised for several years by the original holder until driven out of business by the abolition of overhead wires, and that accordingly the Long Acre company did not have to get a certificate before it issued its first bonds. For similar reasons the Court held that the issue could not be said to be illegal because no consent therefor was obtained. The Court held that these two reasons affected only the question as to how large an issue should be authorized and did not support a refusal to authorize at all.

Justice Scott said that the Court of Appeals had already decided that the franchise title was perfect. As to the commission's ruling that the construction contract did not protect adequately the company or the public Justice Scott says it showed a disposition by the commission "to substitute their judgment for that of the board of directors or stockholders of a corporation as to the wisdom of a transaction," which the Court of Appeals has said they have no right to do. "This objection seems to be wholly arbitrary," said Justice Scott, "and our own examination discloses nothing apparently so objectionable as to warrant condemnation."

Justice Scott said that it had been the general policy of the State to encourage beneficent monopoly. The court ruled, however, that the right to determine whether competition is to be permitted rests with the Legislature and has not been delegated to the Public Service Commission. The case differs, the Court held, from the application of a railroad company, where the commission may properly withhold its consent to a franchise because the territory to be served is already sufficiently served, and in which case a certificate of necessity and convenience is required. The court accordingly referred the application back to the commission "for consideration and action within the limits of its authority."

In his minority opinion Justice Ingraham said he did not understand that the Long Acre company's right to use its franchise had been passed upon definitely by the Court of Appeals. He said that if the State had the power to question the right by the company to the franchise, the commission, as State officers, had the same right.

Justice Ingraham said that whatever franchise the original holder claimed to have had in 1889 or 1893 it had abandoned and for 20 years. For that reason it was practically extinct. "It seems to me to be a violation of the spirit as well as the letter of the statute to claim that such a franchise can be revived after such a period of time and allow the exercise of the power then granted without the consent of the defendants. Here is a corporation without property with a franchise, and the legality of which is doubtful, with stock or bonds that have been issued that are at least of doubtful validity, asking to be allowed to issue $50,000,000 of bonds and $10,000,000 of stock without really showing that it is practicable to use any of this stock and bonds in the working of its franchise or providing for the necessary property therefor."

Two courses are now open to the commission—either to proceed with further hearings and determination of the case or to appeal to the Court of Appeals. It was intimated that an appeal would be taken.

Test of Missouri's Energy-Theft Law.

Missouri central-station operators are watching with interest the progress of a criminal case which will shortly come up for trial in St. Louis, where the State, on the complaint of the Union Electric Light & Power Company, is suing a saloonkeeper for theft of electrical energy. The peculiar provision of the Missouri law, which requires proof to be shown that the energy thief knowingly received the unmetered energy has up to this time made convictions for tampering with electric meters or service wires exceedingly difficult. For the electric company itself to bring suit against the culprit has usually been considered inadvisable in that state on account of the difficulty of securing conviction, followed by the possibility of a damage suit for defamation of character brought by the defendant. In order to bring the case before the prosecuting attorney for official action it has been necessary to show definitely that the energy was knowingly stolen, and this has also been difficult. Recently, however, employees of the Union company entered the establishment of the saloonkeeper, and, after loitering a while, gained from the conversation of several electricians who were in the place that something had been done to the meter. Explaining to the saloonkeeper that it was necessary for them "to measure the pressure" at this place and again at another point farther up the line (for which purpose, they said, they would have to have access to the meter) they succeeded at once in getting the vigorous advice from the proprietor to measure the distant point first. Finally, after consulting among themselves, the inspectors decided that the local situation needed attention first, and after insisting that they be taken to the meter, where they noticed an extra jumper shunting the series coils, they were ordered out of the place by the saloonkeeper. Turning to go, they were rewarded by seeing him jump to the meter and jerk down the jumper, this act resulting in thorough evidence that he had knowingly received unpaid-for electrical energy, according to the terms of the state law.

This is one of the first instances in which it has been possible to get complete evidence in a case of this kind, and the resulting action will be watched with a good deal of interest by all electric-light managers in the State of Missouri, who have had cases dealing with the theft of electrical energy.

Ohio Independent Telephone Situation.

The committee appointed by the Ohio Independent Telephone Association to confer with President Frank A. Davis, of the United States Telephone Company, in regard to the establishment of a scale of rates, has about completed the work of conferring with the Independent telephone men over the state, having seen almost all of them. They will meet President Davis at an early date and lay before him the data and information they have gathered, in order that he may make use of them in making up a new schedule under the authorization made by the board of directors some time ago.

On Wednesday of last week the Elson telephone merger bill, which passed the House of Representatives recently, was defeated in the Senate by a vote of 19 to 14. The opponents of

the bill had claimed its defeat the day before by only one vote and they were, therefore, rather surprised at the strength shown when the final vote was taken. This bill had been amended in such a manner that most of the objectionable features were eliminated, but the scandal it caused in the House of Representatives was perhaps the ultimate cause of its defeat. The legislative investigating committee had reported that while they did not find from the evidence that any of the members of the House of Representatives were culpable, they did, however, find in at least one instance that an attempt was made to bribe a member to support the Elson telephone measure. The case referred to is the charge that an employee of the Bell interests is connected with the allegation that Representative Howard W. Pears, of Allen County, was offered a sum of money to vote for the bill. Indirectly the report brings in some other names, but no direct charges are made in connection with them. The evidence will be presented before a grand jury.

Following the defeat of this bill there was talk of an amendment to the Woods public utilities bill, making interchange of service between competing companies, operating intersecting lines, mandatory. This would put the regulation of the service under the commission. The matter was referred to the Attorney-General for an opinion as to its constitutionality. It is said that the utilities bill will be so amended as to take away the authority of the commission to make initial rates for public-service corporations, but it will still have power to adjust excessive or discriminatory initial rates when complaints are made.

Electrification Situation at Boston.

Public opinion in favor of electrification of the steam railroads at Boston continues to exert pressure upon the Legislature for early action requiring the adoption of electricity in the metropolitan district. A long statement was issued last week by Mr. W. C. Ewing, chairman of the committee on transportation of the United Improvement Association, refuting some of the arguments of counsel at recent legislative hearings against electrification. It was pointed out that while the advantages of eliminating the smoke nuisance had been given considerable emphasis at hearings before the legislative committee on metropolitan affairs, the great transportation advantages of electrified service have repeatedly been brought out before the Legislature. Economy of operation derived from the running of short and frequent trains will benefit the public and the railroads. Short, frequent trains are exactly what the suburbanite needs. The flexibility of electrification will give more frequent service at reduced cost; the elimination of switching will be most advantageous, and overcrowding will be diminished. With more frequent and cleanly service population will be attracted to the suburban territory as it is not under the present regimé. The traffic of the railroads will be greatly increased by the introduction of electric service. The Railroad Commission and the joint board of metropolitan improvements are strongly in favor of electrification, and it is contended that it is time for the Legislature to take definite action requiring the railroads to make a positive move in the matter instead of postponing the introduction of a type of service desired by practically the entire population of eastern Massachusetts.

Proposed Utilization of Hydroelectric Energy from Mississippi Deep Waterway.

In addressing the Rivers and Harbors Committee of the House of Representatives, and also later in conference with President Taft, Mr. Lyman E. Cooley, the well-known engineer, advanced some interesting ideas in relation to the proposed deep waterway in the Mississippi River. Among other features of his plan, Mr. Cooley proposes to build two dams across the river, one 8 miles below St. Louis and the other 36 miles above Cairo. Between the mouth of the Illinois River and Cairo there is a fall of 132 ft. in a distance of 212 miles. The proposed dams will back up the water at each location and give a head of 40 ft. at each dam. This will make the slope of the river below each dam much less steep than is at present the case. The water-power which can be developed by these dams is estimated by Mr. Cooley to be at least 400,000 hp. If sold for commercial purposes it will produce a financial return of large proportions.

Mr. Cooley considers the deep-waterway project, as he has studied it, in three sections. These are the Illinois and Desplaines Rivers from Chicago to the Mississippi, the Mississippi from the mouth of the Illinois to Cairo, and the Lower Mississippi from Cairo to the Gulf. The plans are intended to secure at least 14 ft. of water in the Mississippi below the mouth of the Illinois River. The details of cost have not been figured out carefully as yet, but it is believed that the improvements contemplated in Mr. Cooley's plan could be made for $50,000,000 or less.

Mexican Electrical Developments.

Gov. Enrique C. Creel, acting on behalf of the State of Chihuahua, has granted to the Mexican Securities Corporation, Ltd., of Halifax, Nova Scotia, a concession for the establishment of 10 electric lighting and power systems for the State. It is regarded as one of the most valuable concessions ever granted in the State as it gives that company the exclusive right to install and operate its plants in the towns of Santa Barbara, Villa Escobedo, Zaragoza, Sancillo, San Francisco de Conchos, Rosales, Naica, Meoqui, Aldana and Santa Eulalia. The Mexican Securities Corporation, Ltd., is closely allied with the Mexican Northern Power Company, the Canadian concern which is constructing a great dam and hydroelectric plant on the Conchos River, 17 miles from Santa Rosalia, under a concession granted by the Government of the State. It is stated that the latter company will build transmission lines to all the towns embraced in the concession that has just been granted to the Mexican Securities Corporation, Ltd., and that it will provide the electrical energy for operating the different sub-lighting and power stations. In addition to furnishing the subsidiary company with power for its several towns and mining camps, the Mexican Northern Power Company will build transmission lines to the cities of Chihuahua, Parral, Jiminez and probably other places, and carry on a lighting and power business in each of those cities on its own account. The terms of the concession granted the Mexican Securities Corporation, Ltd., provide that it must have its lighting and power systems installed in each of the 10 towns within one year after the completion of the hydroelectric plant which the Mexican Northern Power Company is installing on the Conchos River. The company is building a standard-gage railroad from Santa Rosalia to the site of the great dam which it is constructing across the river.

In line with its policy of encouraging railroad building, the State of Durango has granted a concession to Francisco Neugebaurer for the construction of an electric or steam line from Tepehuanes to the Guanacevi mining district. The State government guarantees for a period of 25 years 6 per cent per annum on the amount of money that may be invested by the company which will be formed for constructing the line. The Government will also donate the right-of-way and depot and terminal grounds. It is specially stipulated that in case the earnings of the road do not amount to 6 per cent, the State Government will make up the deficiency. The proposed road will connect with the International division of the National Railways of Mexico at Tepehuanes. It will be about 50 miles long and will penetrate a very rich mining district that is now remotely situated from railway transportation facilities. An investigation is being made by Mr. Neugebaurer of the relative cost of installing electric equipment for operating the proposed road and that of operating it by steam. It is thought that an available site for a large hydroelectric plant for providing power for the road in case electric transit is adopted may be found in the mountains adjacent to the line. The head-

quarters of the road will be in Durango. The concession also authorizes the construction of telephone and telegraph lines.

Howell Patent for Method of Exhausting Incandescent Electric Lamp Bulbs Held Valid.

In holding patent No. 726,293, dated April 28, 1903, issued to Mr. John W. Howell and relating to a method for exhausting incandescent lamps, valid in a recent action for infringement, the United States Circuit Court of Appeals, speaking through Judge Coxe, said:

"The defenses relied on are lack of patentability and non-infringement. Notwithstanding the formidable and, at times, well-nigh incomprehensible nomenclature of the electric lighting art, the invention is, in fact, an exceedingly simple one. It is not a fundamental invention, it did not revolutionize the art, but by the substitution of an ordinary pinch-cock for heat in closing the connection between the lamp and the pump, it has accomplished a most useful and beneficial result with a corresponding economy of time, labor and material.

"The patent purports to be, and is, an improvement upon the invention of Arturo Malignani for a process of evacuating incandescent lamps. This patent need not be discussed here further than to say that the process of the patent in suit is Malignani's process with the substitution of the pinch-cock for the soldering of the lower end of the tube by heat.

"The fact that the invention is simple and that at the present time it seems as if it might have been obvious to the workers in this art does not militate against its validity. Many of the most useful inventions depend upon equally simple changes. The important question is: What does the invention do?

"Tested by results we think it quite clear that the patent discloses patentable novelty. The testimony shows that the Howell process saves time, material and the use of skilled labor. It makes better and cheaper lamps and more of them, avoids discoloration of the bulbs and permits an instantaneous and controllable closure. These are some, but not all, of the practical results obtained by using the patented method."

Wire Connector Patent Litigation.

The United States Circuit Court for the Southern District of New York has declared invalid a patent granted June 5, 1904, (No. 521,018), to James Y. DeMott on a connector for electric wires. The American Electric Fuse Company was defendant in the case, the complainant being William M. Keepers, against whom the costs of the suit were assessed.

The court stated that in view of the prior state of the art the scope of the patent claim in controversy must be restricted to an open joint which is formed by turning a single piece of metal to form a substantial loop, leaving the edge open so that jointure may be made by crimping or pressing after the wires have been run through the tubing. It was old at the date of the invention to run electric wires through two rigid tubes or sleeves joined together. Such a device for inserting the ends of telegraph wires was first shown in the McIntire patents (Jan. 1, 1884, and Aug. 1, 1886). It was old to use an open-joint connection made out of a single piece of metal, as may be ascertained by an examination of the patents of McIntire (Aug. 7, 1886), Coleman (Feb. 2, 1892), and Hering (March 13, 1888). The still earlier patent to Smith (No. 198,471) suggests the idea of turning the ends of the metal into a central rib or web of the plate to make double tubes. Moreover, it has been held that invention is not disclosed by merely making in a single piece a device or connection which previously had been made of separate parts.

The court stated that the file wrapper of the DeMott patent in evidence indicates that originally there were broad claims insisted upon by the patentee, but eventually he accepted narrow claims which restricted the invention to the precise method described, namely, forming an open joint at the inner edge of the tube out of a single piece of metal. As the DeMott patent has not gone into use its novelty cannot be tested by its success. But assuming novelty and a limitation of the claims by the Patent Office, the court held that the defendant does not infringe the patent, for it uses a closed tube as distinguished from one that is open for the purpose of making a joint after the wire is imbedded in the tube. The edges of the tube and the rib are brazed and when the wires have been run through the tubes are twisted to tightly enclose and hold them. A decree was ordered dismissing the bill with costs.

Priority Awarded to Peter Cooper Hewitt for Invention of Mercury-Vapor Rectifier.

The issue last week to Peter Cooper Hewitt of two patents on the principle of the mercury-vapor rectifier marks the close of a contest in the Patent Office over this apparatus dating from 1904. The applications for the Hewitt patents were filed April 5, 1901. On Oct. 18, 1902, Mr. E. Weintraub, of the General Electric Company, filed an application for a patent involving a specific principle of the mercury-arc rectifier. The contest in the case began the following year, although a formal interference was not declared until May 24, 1904. Motions and appeals delayed final action in the Patent Office until 1909, priority at each step being awarded to Mr. Hewitt. The case was then taken to the Court of Appeals of the District of Columbia, which upheld the judgment of the Patent Office in an opinion filed March 1, 1910, thus leading to the issue, as noted, of the Hewitt patents last week.

The Court defined the invention as "the combination of an hermetically sealed enclosing chamber, a gas or vapor path therein, a plurality of positive electrodes and a common negative electrode, each of the positive electrodes being connected with a separate source of current."

The Court quoted the Patent Office board of examiners as follows concerning the difference between the Hewitt and Weintraub devices: "Each instrument contains a plurality of anodes and a single cathode, the latter co-acting with each of the anodes. Weintraub has a source of alternating current connected between one anode and the cathode which furnishes the main current, and an additional source of current, which is direct or continuous, connecting the other anode to the cathode, so that whatever the condition of the source of alternating current, a direct current is constantly maintained. Hewitt, on the other hand, has each of his anodes connected to an individual or distinct coil of a polyphase generator of alternating current, the currents supplied to the several anodes being so related in phase that the impulses overlap; that is to say, conjointly they continually supply current to keep up the excitation of the cathode."

The Court stated that the date of conception alleged by Weintraub in his preliminary statement is subsequent to the filing date of Mr. Hewitt, but it was contended that Mr. Hewitt was not entitled to make a claim corresponding to the count of the issue, because the phrase "a separate source of current" cannot be read on the Hewitt device. The Court held it to be true that if the current through any one of the anodes in the Hewitt apparatus should fail, the operation of the device would be discontinued, while in the Weintraub device if the alternating current is interrupted, and then renewed, the lamp will start without assistance, provided the direct current remains constant. This, however, is was decided can have no effect on the right of the basic claim sought; and if the Weintraub device is an improvement on that of Mr. Hewitt, he is entitled to claim it specifically, but not broadly.

In addition to the contention as to the terms "separate sources of current" the lengthy litigation also covered alleged errors in technical procedure, including a charge of improper refusal of the Patent Commissioner to permit the taking of testimony of experts, which refusal was, however, upheld by the Court.

Electrical Trade Conditions in the Far East—IV.

By Francis B. Crocker.

Water-power is available in large or considerable quantities in many regions throughout the Far East, including India, Ceylon, Malay Peninsula, Java and Dutch East Indies generally, Philippines, China and Japan. The greater part of all of these countries is mountainous or hilly and the total annual rainfall is usually large and in many places enormous. For example, at the site of a projected 40,000-hp hydroelectric plant 42 miles from Bombay, the rainfall for the year exceeds 200 in., which is five or six times that of the wetter regions of the United States. In most of these countries nearly all of this rain falls during a few months. Hence, to generate power for the dry season, usually more than half of the year, it is necessary to have large natural or artificial reservoirs. Fortunately, the roughness of these lands favors their existence or construction. In Japan, the rains are not only copious, but fairly well distributed throughout the year, so that large storage capacity is not required and all of the conditions are very favorable to the development of water-power. The natural consequence is that hydroelectric plants are being installed or projected in all of the countries mentioned and in Japan there is a veritable boom in this branch of electrical engineering which directly stimulates the progress of other branches, including electric lighting, railways, stationary motors, heating apparatus, etc. With the exception of Japan, these countries have as yet made only a small beginning and because of their exceedingly deliberate manner of procedure, their advance in this or any other direction will be slow. Beyond question, however, the total value of hydroelectric apparatus with the corresponding railway, lighting, power and other equipment, as well as supplies, that will be installed during the next 10 or 15 years in the Orient as a whole, must reach enormous figures. Nearly all of this apparatus will be made in Europe and America and here is one of our great opportunities to export our manufactured products. To what extent are we to avail ourselves of it? Again Japan is the exception among all Eastern countries because she will manufacture electrical machinery and supplies, but for 5 or even 10 years she will not supply all of her own wants in this direction. At the present time, not more than 10 per cent of the electrical apparatus used in Japan is made in that country.

In the Far East the stationary electric motor is by no means such an important feature of electrical progress as it is in the United States. This is the very natural result of exceedingly cheap labor in the former and exceedingly high-priced labor in the latter. In Oriental countries one often sees logs 1 ft. or 2 ft. in diameter and 10 ft or 20 ft. long that are being sawed by hand into boards or planks. Practically all of the passengers and goods in the very large city of Canton are carried on the shoulders of men. This includes building materials, bales of merchandise, live hogs, and other heavy weights. Similar conditions prevail in all Eastern countries except that there are some vehicles drawn by horses, but usually much fewer than in Europe or America. In Ceylon, Singapore, throughout Japan, also in other places, the jinrikisha, which means "man power," is practically the only conveyance for persons or baggage except where the electric railway has been introduced and even there they continue to exist and seem almost as numerous as ever, for example, in Tokyo. The saving of "man power" is, therefore, far less important there than it is under our labor conditions. In the larger manufacturing establishments, however, such as the cotton mills of Bombay and the cigar factories of Manila, electric motors are used in considerable numbers and will inevitably be introduced more and more as time goes on. Whenever the source of power is a steam or gas engine or waterwheel, the electric drive has practically the same many advantages over belting and shafting in all countries, so that Oriental mills, factories, machine shops, printing offices, etc., will adopt the former means of transmission either at the start or later, just as they do in this country.

One of the applications of the stationary electric motor which is likely to become important is in connection with the very extensive irrigation systems of India and Egypt. Ordinarily water is supplied to the land directly from rivers or from reservoirs by gravity, but in many places the topography may be such that much additional area can be reached by raising the water to a moderate height. Electrically driven pumps are most convenient for this service, and when they can be supplied with energy from hydroelectric plants located at points where the water falls, the results are likely to be especially advantageous. Such combinations have been put in operation by the Reclamation Service in our Western States and will surely be increased in number as well as extent with the development of irrigation in this and other countries. Wherever the water supply is from artesian wells that do not flow or exert pressure above the ground level, of course it is necessary to employ pumps which may, in many instances, be economically driven by electric motors. In fact, any water that is thus pumped from a river, lake, well or other source and used to moisten soil or vegetation is a case of what might be called electrical irrigation. Small and large examples of these various kinds will be steadily, and in all probability, rapidly developed in most countries, whether Eastern or Western, especially as farm and garden land is everywhere being used up both in quality as well as quantity. This one application of electric power will undoubtedly demand large numbers of motors.

The telegraph being the oldest branch of electrotechnology has had time to become established in the very conservative Orient. Together with the telephone it is usually operated by the Government which is strongly paternal in most Eastern countries so that a few intelligent men decide the matter without regard to immediate profit and without waiting to educate the masses, as is commercially necessary in order to introduce electric light, railway and stationary motor service ordinarily controlled by private corporations. This cannot be taken as an argument favoring government or municipal ownership in America, because with us the masses are very quickly educated to accept new things, in fact, just because they are new. Moreover, it would be an invidious discrimination and base flattery to imply that Congress and aldermanic boards are composed of intelligent men. To insert the word "few" would make a bad matter still worse! There is still another reason for the introduction of the telegraph and telephone which is sufficient even if there were no other and that is its strategic value. In India there is a vast population of nearly 300,000,000 held down by an army less than 1/10 of 1 per cent as numerous, and much more than half of these troops are natives of somewhat doubtful loyalty. The ratio of soldiers to population, which is *less* than 1 to 1000, is about the same as in the United States, which is considered to have an exceedingly small standing army. It is very obvious that the earliest possible information of any disturbance or an acute case of what is politely called "unrest" is of the utmost importance to the Government and military authorities. It is nothing short of marvelous that the British are able to control India as well as they do and it is only by the aid of means for rapid communication as well as their all-reaching secret service so well described in "Kim" by Kipling. It is often said that news of trouble "up country," or in distant parts of India, reaches the Calcutta bazaars, where the natives congregate, before it is known in Government House. It is even claimed that telepathy, or other mystical (probably mythical) agency, is invoked. Undoubtedly, news does travel very fast in those countries, because they have been practicing this sort of wireless communication for thousands of years. Whatever the explanation, the Government certainly needs the best telegraph and telephone systems obtainable. The pole-line construction is excellent, usually with iron poles that are made, set and braced according to standard specifications in first-class engineering fashion, compared with the clothes-pole, haphazard methods formerly universal and still too common in American telegraph line work, in spite of the good examples set by energy transmission and telephony.

The high-grade line construction in India is designed to avoid as far as possible accidental or intentional interruptions, particularly undesirable in that country. The telegraph, also the telephone instruments and apparatus, are not as up-to-date as the out-door work. For military or other governmental pur-

poses the *continuity* of communication is essential, but it is only for commercial service that the ability to handle many messengers is very important. As time goes on, the bulk of private business will grow more rapidly than the governmental, so that improved apparatus and methods will be demanded for telegraphy as well as telephony. In fact, commercial and personal business will undoubtedly be paramount as it is with us, especially as wireless telegraphy masks the ordinary kind strategically less important. The general condition of these arts in Egypt, Burma, Ceylon, Malay Peninsula, Dutch East Indies, Philippines, Japan and China is similar to that of India, except that the last-named country is more backward in all electrical development. Briefly stated then, in all of these lands the telegraph is well established, originally and necessarily for Government purposes, but now used also to an important and increasing extent by the general public, so that more modern station equipment is needed.

The telephone, still regarded as a new thing in the slowly awakening Orient, is decidedly undeveloped. Even Japan, which is advancing rapidly in all electrical applications, does not introduce and use the local or long-distance telephone to anything like the extent that we do, there being only about 100,000 telephone subscribers in all Japan. In all other Eastern countries there is hardly any long-distance service and the local business is exceedingly small compared with that of American cities and towns of equal population. Long-distance telephony seems to be an acquired taste; even in the United States it developed much later and more slowly than the local service. The Oriental, excepting in Japan, seems to have very little desire for it, but, of course, it will gradually be introduced and extended as its utility becomes appreciated. The total amount of telephone and telegraph apparatus, supplies, etc., although installed in those countries more slowly than here, will nevertheless be enormous during the next 10 years and afterward. Very little of it will be manufactured in the East except a certain fraction of what Japan requires and will make herself. In this direction, therefore, we have another of the many grand opportunities for exporting our manufactured goods. Of course, if our standard of living requires every workman to have an automobile and a pianola, the high cost of labor will prevent our successful competition with European manufacturers, but the opportunities are there for somebody.

Electrical Production of Nitrogen Compounds.

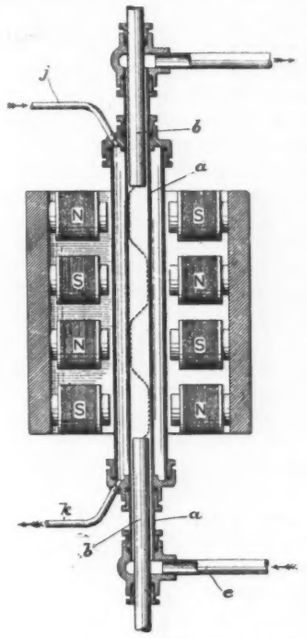
Commercial users of nitrate products on a large scale are coming to recognize the importance of supplementing their supply from the fast-disappearing saltpeter beds of Chile in South America. The manufacture of almost every kind of explosive is dependent upon the use of nitrogen compounds, so we shall not be surprised to find powder makers viewing seriously the extraction of this important element from the air by electrical means. The production of nitrates from the atmosphere is yet generally considered uneconomical in this country, although important undertakings are in successful operation in Norway, where electrical energy may be purchased at a figure one-third to one-fourth of that offered in America.

A recent patent secured by Francis I. du Pont, of Wilmington, Del., and assigned by him to the E. I. du Pont de Nemours Powder Company, relates to the direct combustion of atmospheric nitrogen by the oxygen with which it is mixed in the air. This action of producing nitrogen oxide is carried out in the presence of an electric arc or flame, as has been done in a number of earlier methods, removing the simpler oxides to a cooled chamber where it automatically passes into the brown peroxide, which may be dissolved in water to form nitric acid or absorbed by alkaline compounds to make nitrate salts.

The novelty in the present arrangement of the arc or flame consists in confining it within a tubular chamber fitted with means for setting up a rotating magnetic field which causes the arc to rotate rapidly, crossing and recrossing the air contents within the tube. The resulting action is to bring the highly heated arc into intimate contact with a large part of the air in the tube, and converting it into the oxide of nitrogen. The combustion chamber is also water-jacketed.

In the drawing the tube *a* is of silica and carries in its end fittings the arc electrodes *bb*. Air is admitted to the chamber at *e*, and passes up and out through *d*. The water in the cooling system flows in the reverse direction, from *j* to *k*.

Surrounding the central tube is a structure carrying a number of coils so arranged that when connected to a source of



Nitrogen-Producing Apparatus.

polyphase supply, rotating fields are set up which react on the arc, dragging it into similar rotation. These fields successively differ by 180 deg., adjacent poles in line being made alternately north and south, so that the flame is shaped into the sinusoid shown, and at the same time rotated rapidly, securing a large contact with the air to be converted. This spreading of the arc, as well as the successive admittances of the air to the arc path, with intervening coolings from contact with the walls of the tube, has been proven to have an important effect on the acid production accomplished with the expenditure of the same energy. In operation the air is passed in a continuous stream through the combustion chamber, traversing the several cross-paths taken by the rotating arc. In the du Pont device the arc is supplied with current at 5000 volts.

Nebraska Electrical Association Convention.

At the Nebraska Electrical Association convention to be held at Lincoln, Neb., May 3, 4 and 5, the address of welcome will be made by Mayor Don L. Love and responded to by Mr. E. A. Bullock. This is to be followed by the address of the president and routine business. The following papers are scheduled for presentation: "Tungsten Lamps," by Mr. Joel Roberts; "Concrete-Pole Construction," by Mr. C. A. Snider; "Exhaust-Steam Ice-Making," by Mr. Heywood Cochran; report on Iowa convention by Mr. E. A. Bullock; "Power Plant Reports," by Mr. G. S. Sprague; "Power Plant Operation," by Mr. N. A. Kemmish; "Increasing Central-Station Motor Load," by Mr. S. G. Peticolas; "New Business," by Mr. G. A. Barnett; "The Engineering College," by Dean C. R. Richards, of Nebraska Engineering College; "Public Service Commissions," by Mr. E. C. Hurd; "Rates to Be Charged in Cities of from 1000 to 2000 Inhabitants," by Mr. B. L. Smith; "Distribution Systems," by Mr. H. A. Holdrege; "Electric Motors," by Mr. Otto Mallet.

Debate on Status of Quasi-Public Corporations.

The quasi-public corporations from the standpoints of the financier and the public were debated Thursday night, April 21, at the Mercantile Club, St. Louis, by Mr. Henry L. Doherty of New York, and Mr. Fred W. Lehmann of St. Louis, former president of the American Bar Association and chairman of the Board of Freeholders of St. Louis. The occasion was a banquet given by the League of Electrical Interests. On the following evening, Mr. Alten S. Miller, president of the Union Electric Light and Power Co., spoke on the same subject at a meeting of the local N. E. L. A. section. Below are given in abstract the addresses of the several speakers.

The meeting of Thursday was presided over by Mr. Robert McCulloch, president of the League of Electrical Interests and president of the United Railways Co., of St. Louis.

Those at the speakers' table were Messrs. Frank W. Frueauff, of Denver, president of the National Association; James A. Waterworth, president, and Joseph L. Hornsby and James E. Allison, members of the Public Service Commission of St. Louis; Mayor Kriesman, of St. Louis; H. L. Doherty, F. W. Lehmann, T. Commerford Martin, secretary of the National Electric Light Association and H. H. Scott, chairman of the N. E. L. A. membership committee.

In introducing Mr. Doherty, President McCulloch said he was a man who worked every hour, but had set aside all this and had come to Missouri to address the bone and sinew of St. Louis.

In opening Mr. Doherty said we are living in an age which seemed inclined to carry democracy to its ultimatum—to its absurdity. He did not believe that the voice of the people is the voice of God, nor that matters should be regulated to conform to public opinion on the theory that public opinion must always be right. The present strong wave of antagonism against corporations is, he considers, largely misdirected. Many of the things about which the people complain are not harmful, and those that are harmful are not confined to the corporation in contra-distinction to the individual or the partnership. The former is more free from bad practice than the individual or the partnership, as the man willing to resort to bad practice wants as few confederates as possible, and working as an individual or partnership greater secrecy can be had. On the other hand, a corporation must choose officers worthy of the confidence of its prospective stockholders, and, therefore, what constitutes bad corporation practice in the mind of the public is in reality bad business practice, which would be still more accentuated if the modern corporation were succeeded by the individual or the partnership.

Every restriction in the liberality of corporation laws is, he said, a restriction to the development of the country; and while it cannot be denied that bad business practice exists, most of the methods of correction proposed by the public will defeat rather than promote this correction. Mr. Doherty said that one great obstacle toward the needed reform is the modern reformer. A large number of the best and ablest business men of the country are more desirous of correcting bad practice than the volunteer reformer can hope to be, the former having as an incentive all the altruism a volunteer reformer can hope to have, and selfish reasons besides. These men would themselves create the necessary reform if given an opportunity to do so, and if left free from the reform element, which consists largely of impractical meddlers and notoriety seekers who would bring us all to disaster.

As an example of the unnecessary burdens placed on corporations, he referred to the recent federal corporation tax law, under which a private individual carrying on exactly the same character of business as a corporation escaped without any taxation. The great evil of this law, however, is the provision for the publicity of affairs of corporations, which, as carried out, is primarily to give privately organized business concerns information about competitors who happen to be incorporated. Referring to the high costs of living, Mr. Doherty said it would be an easy matter to show by statistics that, allowing for the higher cost of both labor and raw material, the corporation products of the country are on the average constantly diminishing in prices, while non-corporation products are selling at much higher prices. He gave several illustrations to show first, how by liberal incorporation laws the capitalist can be made unnecessary in the up-building of large enterprises; second, that the poor man by means of corporations can, by the exercise of enterprise, energy and industry, become wealthy; and third, that the building of these enterprises means greater profit to the community as a whole than to the builders. Mr. Doherty denied the statement made from time to time that the rich are becoming richer and the poor are becoming poorer. The acquisitions to the rich class are from the poor class, and with proper encouragement to the individual, the partnership and the corporation, and without unfair discrimination, larger and still larger numbers of the poor class of today will become the rich class of tomorrow. It is possible today for the ordinary wage earner to enjoy greater comfort of living than was enjoyed by the monarch of, say, 150 years ago. The number of men who built factories and railroads is all too small, for it is largely by the work of this class that the great masses are kept employed.

Referring to Ex-Forester Pinchot, Mr. Doherty said that he has done more to retard and perhaps permanently prevent the development of many of our water powers than any other man. The rapid development of our various water powers is the only effective means now available for conserving our coal supply, but instead of offering every encouragement to the development of these water powers, Mr. Pinchot's policy seemed to be to retard the development. The stories for which he was responsible as to the existence of a water power trust caused the public generally, together with Federal and State government officials, to restrict in every way the development of water powers; and while Canada and Mexico were offering attractive bonuses for the development of their water powers, the American people were obstructing these developments in every way they could.

Taking up the subject of stock watering, Mr. Doherty said that it is made apparent every day that the original cost of a property is only a small factor in its ultimate value. To illustrate he assumed a case where a water power can be purchased for $50,000, and which would cost $950,000 more to generate and market the power. No one is going to spend this million dollars unless he believes that the enterprise will be worth substantially more than it cost; and in this case no one would be justified in accepting the risk unless it was reasonably probable that the developed enterprise would be worth at least $2,000,000. If then the enterprise is expected to be worth $2,000,000, and the people advance the money solely on the belief that it will be worth $2,000,000, there is no reason for not capitalizing it for $2,000,000. If this water power were developed and found incapable of even earning its operating expenses, no one could contend that it was worth $1,000,000 simply because it cost $1,000,000 to create. This is only one proof that the cost of a property does not fix its value; and in most cases it is simply a question whether one shall wait for natural developments to create a value for a certain property or a certain thing, or whether these elements be quickly produced by expenditures of money and effort.

Returning to public service corporations, Mr. Doherty said that they can be, and often are, a great factor in contributing to the growth and prosperity of a city, but frequently the public, by restricting measures, so hamper the credit of a company that it cannot properly discharge its obligations to the public, much less anticipate the needs of the public. Referring to competition, it is impossible, he said, for two public service corporations of any character to supply a city as effectively and as economically as can be done by one corporation. The folly of such competitive companies was finally realized, and the next step was toward municipal ownership. During nearly two decades numerous municipal enterprises of this sort were established, and almost universally proved dismal failures. Both competition and municipality may, therefore, be looked upon today as practically dead issues. As to short term franchises, all advanced thinkers long ago abandoned the

idea of franchises limited in any way as to time, the policy now being to advocate the granting of franchises in perpetuity, and to provide for the periodical regulation of rates every ten or twenty years. A short-time franchise is one of the most effective restrictions in curtailing the credit of our public service corporations, and in preventing it from anticipating the needs of the community. Corporations thus hampered as they approach the expiration of the period of a franchise, find it impossible to finance their extensions and enlargements, and both the company and the public are apt to suffer greatly. Another feature which has been a source of much annoyance to public service corporations is the special tax for the use of the streets, which represents an unfair tax on the consumer's service in favor of the non-consumer's service. Mr. Doherty quoted with approval an opinion that the theory of franchise taxation is in error, is against public policy, imposes burdens where they do not belong, and in the street railway business imposes burdens on the poorer classes of people.

Referring to the Public Service Commissions of Massachusetts, New York and Wisconsin, and to bills passed in certain other States to establish such commissions, Mr. Doherty said that these bills had been drawn with a breadth far beyond their proper scope, and if fully exercised cannot help but bring disaster, not only to the companies, but to the entire movement. The terms of the Wisconsin and New York bills practically put the management of the companies in the hands of state commissioners, thus presenting the absurdity of properties being managed, not by the owners, but by people having no financial responsibility, a condition whereby the losses will fall on other shoulders than those who make the rates. As to a reasonable return on public service corporation investments, Mr. Doherty said that if the country is to go on and prosper and have the necessary railroad and other facilities, it will have to change its mind materially in regard to what constitutes a reasonable return. If the builders of these enterprises, which are absolutely essential to our development, must be denied all profits, and limited to lower rates of return than can be secured on other classes of investments, or by investment in other countries, then we must depend on either fools or philanthropists to build our railroads and similar properties. The public can limit the earnings of corporations, but it cannot make the people with the means and the talent necessary for the building of our new enterprises create them; and the very fact that an antagonistic sentiment exists against corporations prevents vast numbers of prospective enterprises from becoming realities.

Upon the conclusion of Mr. Doherty's address, President McCulloch in presenting Mr. Lehmann said that he was denied the pleasure of introducing the next speaker, for the reason that every man, woman and child in St. Louis already knew him.

Mr. Lehmann said that while he agreed with the specific expressions of Mr. Doherty, he could not agree with the underlying tone. He took a more favorable view of the question, for he has more faith in human character. He thinks the world today is just as good as it was when he was young, when everything naturally looked bright, if he met it in the right spirit. Final, fixed public opinion is, he considered, the best wisdom we can follow. He did not think that a man who works, though he may not get what he earns, is a pauper and unqualified to add to general public opinion. The only paupers he recognized are those who get from the world more than they give to it. The general sense of the public as a criterion of action is much more likely to be right than a special sense.

The wants of man, he said, are not the same in this generation as they will be in the next. Trouble comes into this world in order to give brains a chance; if the manager of a railroad had no trouble with railroad legislation he could perhaps be employed for $50 a month. Referring to the complaint of the corporations that they are being oppressed by restrictive legislation, he said that in 1878 there were but six corporations in the United States; in 1900 there was one corporation to every 25,000 of population, and to-day there is one corporation to every 225 of population; this rank growth, he believed, does not indicate that corporations have been oppressed. Referring to restrictive railroad legislation in Missouri, he said that the corporations had there a period of 40 years of entire freedom, which freedom they abused and forgot they were public institutions and existed only by the authority of the people. The foundation of many private fortunes to-day were laid in the rebating which railroads formerly practiced. There never was, he said, a rate of transportation enacted or even proposed by the so-called "Granger" laws which was as low as the railroads themselves were then giving to some favorite shippers. The movement of legislation in this particular has been, not for a reduction in rates, but for an equalization of rates. Watered stock was, he believed, at the bottom of the opposition to corporations. Corporations, he thought, should not ask for perpetual franchises with a right to charge the same rate perpetually. The man who invents a useful article is given only 17 years of monopoly; a corporation should be allowed a proper time in which to recoup for the risk they run in launching a project, but after they should not expect more on the investment than the usual rate.

In 1886, he said, agitation was begun for an interstate commerce act, and the leaders in the movement were denounced as incendiaries, agitators and professional confiscators; but time has proved them wise. So, too, he believed, the future would prove the sagacity of those who, reproached and browbeaten as reformers to-day, are fighting for the national corporation act in order to turn the light of publicity into the dark recesses of corporation practices. The corporations, Mr. Lehmann said in conclusion, have been wanting in respect to public intelligence; they have made no attempt to conciliate the public, but have preferred to deal with the elected representatives of the public. At every session of the Missouri Legislature for years the railroads have maintained lobbyists that one would not trust out of sight, or even out of reach, with his pocketbook. When these lobbyists were questioned in the courts respecting dealings with the Legislature they declined to reply, for fear they might incriminate themselves.

At the conclusion of the address Mayor Kriesman expressed the hope that what he had heard would enable him to be a better Mayor.

At a meeting of about 200 members of the local section of the National Electric Light Association, held at the offices of the Union Electric Light & Power Company, on the night after the addresses of Messrs. Doherty and Lehmann, Mr. Allen S. Miller, president of the Union Electric Light & Power Company, in speaking of the obligations assumed by a corporation when it procures a franchise, said he did not agree with Mr. Doherty in many of the views expressed by him on the previous evening. Mr. Miller declared that it was the duty of public-service corporations to maintain frank and just relations with the press. "We should earn the good will of the newspapers," he said. "They mold and sway public opinion and make a daily impression directly upon the public. This can be done by a fair policy on the part of the corporation, with frankness and confidence. Guided by broad and enlightened management the newspapers are seldom led astray. If they are deceived they soon learn it."

Defining a franchise to be the power of a corporation to exercise various rights and privileges, President Miller continued: "These rights are the creatures of law and exist solely by sovereign grant. They spring from the people, from that power which resides only in the people, and it is important for us fully to appreciate that all franchises are necessarily bestowed by popular will. They are privileges which the people have delegated to their fellow men, to do for them what they cannot reasonably do themselves. A corporation must not wrongfully or unlawfully assume to take that which does not rightfully belong to it. The by-laws of a corporation and its proceedings must not be inconsistent with its charter or with the general laws of the land. Equity in dealings with the public is a supreme and vital obligation."

Convention of Iowa Electrical Association.

The Iowa Electrical Association held its tenth annual convention at Sioux City on April 20 and 21 in the New Auditorium. The address of welcome was delivered by Mayor Albert A. Smith, the response being by Mr. L. D. Mathes.

President F. B. Brownell, in his annual address, said that today vested rights are held in higher esteem than in former years and municipal governments no longer look upon public utilities as properties which they may render undesirable by prohibitive measures and then take over at a sacrifice. The regulation of the industry by commission seems to be present in the minds of all. Some are skeptical, while others are of the belief that through an intelligent public-utility bill the bone of contention between the consumer and operator will, to a great extent, be removed.

The convention then took up committee reports. The committee on grounded secondaries presented a report giving the results of tests carried on at the State College on different types of grounds. These tests were on copper and aluminum plates, and on galvanized-iron pipe. The tests were all in black soil. The highest resistance observed was 28.1 ohms, which was on a piece of 1½-in. galvanized-iron pipe driven 3 ft. into the earth. Taking the results as a whole, however, galvanized-iron pipe driven 10 ft. and 15 ft. into the earth gave the lowest average result, being lower than plates 1 ft. square buried 5 ft. 6 in. deep, either in earth or charcoal. The soil was fairly typical of Iowa conditions.

Mr. William H. Spiller, of Kansas City, in a talk on producer-gas plants, gave a brief review of the present condition of the gas engine and the producer-plant situation. A paper on accounting by Mr. A. W. Zahm urged members of the association to secure and adopt the classification of the National Electric Light Association. He said that such a classification will soon be ready and could be obtained by the secretary for general distribution to members.

Prof. L. B. Spinney read a paper on "Regulation and Illumination." He urged a more thorough exploration of the actual voltage conditions existing at consumers' sockets. Many companies have little idea of the actual conditions. One central-station plant tested showed a 40 per cent variation in candle-power within 24 hours; another showed 24 per cent variation. Such fluctuations cause dissatisfaction.

Mr. Adrian Tobias gave some practical suggestions in a paper on meters, dealing especially with the attitude of the Lafayette company toward the public in connection with complaints as to the accuracy of the meters. In small companies there are frequently returned to the manufacturers on complaint of the consumer meters which really need nothing more than cleaning up.

Mr. J. P. Jones outlined some interesting results on the life of tungsten series street lamps, which have been in operation in Cedar Falls since July 11, 1908. His figures showed marked improvement in the life of lamps installed during the last year as compared to those previous to that time.

Mr. H. F. Stevens gave a short talk on district exhaust-steam heating. He said that certain of the early installations had not been successful because they were not installed with proper understanding of the conditions. The best heat insulation for underground heating pipe is wooden pump log, which should be underdrained with tile or broken stone. Charging should be on the meter basis, as in the electrical business.

REGULATION BY COMMISSION.

On Thursday morning an address was delivered by Hon. J. U. Sammis, a member of the Iowa State Legislature, on the "The Regulation of Public Utilities." He gave his reasons why a law for regulating all public utilities by commission should be enacted. The question has its business and its moral sides. While such regulation is good from a business standpoint it is even better from a moral standpoint. It is good business for the companies, and morally right because it prevents discrimination. Three states, namely, Wisconsin, New York and Massachusetts, have comprehensive public utility laws. Iowa should not be behind, but to the fore in these matters. One of the curses resting on political matters in several states is the participation of public-utility companies in politics. Partly from choice and partly from necessity such companies have sought to bring about the election of officers favorable to the companies. This is bad, both for the companies and the public.

In Iowa it has become generally recognized that regulation of railroads is proper, and such regulation has been in force for a number of years. There is no reason why a railroad should be singled out among public-service corporations. If it is right to regulate the railroads, other public-service corporations also should be regulated.

The whole question is whether the rates of electric and water companies should be controlled by a state commission or by the various city councils. He then asked the questions: "As investors, which would you prefer? As consumers, which would you prefer?" From the investor's standpoint proper regulation by commission would improve the efficiency of administration by bringing about uniform methods of accounting and the intelligent comparison of one plant with another would be made possible. It would also give stability to the investment by protecting the investors. From the consumer's standpoint it would abolish the baneful practice of rebates and discrimination. At present questions in which the companies and the cities are interested are decided by the City Councils. The City Councils are of necessity prejudiced in favor of the city's side of any case. Disputes should be decided by those disinterested and not by one of the interested parties. A state commission should be a disinterested body. A great step would be made if questions pertaining to public utilities could be taken out of politics and placed in the hands of disinterested parties. During the past few years there has been a frenzied desire to legislate in various states, with the result that some legislation has been good, some indifferent and some positively bad and illegal. Under the latter class he referred to some of the hasty railroad legislation which had been overthrown by the courts.

The speaker explained the working of the franchise provisions in the Massachusetts and Wisconsin laws, under which the company enjoys a franchise as long as it obeys the laws of the state and the rulings of the commission, and need have no fear while it operates in conformity with these laws and rulings. However, if a company shows itself unwilling or unable to obey the laws and properly serve the public its franchise may be annulled. Some will also argue against the commission plan that it creates a monopoly. He maintained that these public utilities should be public monopolies, if conducted properly, and that they can be best conducted as regulated monopolies. There is a vast difference between a private monopoly and a public monopoly with all of its affairs made public and properly regulated.

The members of the commission should be experts and should have legal means to secure the necessary information. City Councils have no expert knowledge; their members have neither the time nor the inclination to study into these matters. Public-service companies ought to expect fairer treatment at the hands of the commission than at the hands of the City Council.

Mr. H. G. Glass, of Pittsburgh, read a paper on "Methods of Increasing the Day Load of Central Stations." This was discussed at some length and drifted into a discussion of non-peak rates, from which it appeared that considerable business is being done on non-peak contracts.

In a talk on rates Mr. J. R. Cravath stated briefly the general principles of rate-making which are now finding general acceptance where such matters have been studied, and then took up the recent state commission decisions in various states which showed the trend of such decisions on rates. After a somewhat extended discussion on this question, Mr. Harry Glass, of Pittsburgh, spoke of the advantages of membership in the National Electric Light Association. He showed the extensive amount of information and literature which is

available to the members, and dwelt on the advantages to small companies of getting questions answered by some of the best men in the country in different localities.

The convention went into executive session for election of officers, decision as to next meeting place and other matters. The election of officers resulted as follows: President, Mr. Thomas Crawford, of Clinton; vice-president, Mr. L. R. Crawford, of Sioux City; secretary, Mr. W. N. Keiser, of Dubuque; treasurer, Mr. W. A. Mall, of Belle Plaine. Executive committee, Mr. L. D. Mathes, of Dubuque; Mr. H. C. Blackwell, of Davenport, and Mr. A. L. Dodd, of Charles City. Davenport was selected as the place for the next convention in April, 1911.

The president-elect of the association, Mr. Thomas Crawford, of Clinton, is general manager of the Clinton Gas Light & Coke Company and of the Maquoketa Light & Heat Company. He has been general manager of the Clinton Gas Light & Coke Company for the last five years. Mr. Crawford is 36 years old and was born and raised at Sterling, Ill. He received a high-school education and graduated from the University of Illinois in the electrical engineering course in 1894. Previous to taking this course he had worked in various capacities for the Sterling Gas & Electric Company. Upon leaving college he immediately became superintendent of that company, which position he held from 1894 to 1905. In 1905 he went to Clinton.

At 10 p. m. on Wednesday evening the supply house and manufacturers' representatives gave a smoker at the Mondamin Hotel.

On Thursday evening the Sioux City Service Company, the Sioux City Traction Company and the Sioux City Gas & Electric Company gave a theater party to the attendants at the Iowa Electrical Association and the Iowa Street and Interurban Railway Association.

Meeting of the National Association of Cotton Manufacturers.

At the annual meeting of the National Association of Cotton Manufacturers, held at Boston, April 27 and 28, a number of engineering papers of general interest were presented. Among these were "The Electric Drive as a Manufacturing Proposition," by Mr. Meldon H. Merrill; "The Buying and Handling of Steam Coals in New England," by Mr. John S. Lawrence; "Superheated Steam and Superheaters," by Mr. D. S. Jacobus; "Cost of Energy for Textile Mills," by Mr. Charles T. Main; "Progress of the Diesel Engine," by Mr. E. D. Meier; and "The Distribution of Artificial Light," by Mr. Frank M. Scantlebury.

In the paper entitled "The Electric Drive as a Manufacturing Proposition" the author emphasized the tendency of previous papers on this topic to advocate specific commercial apparatus and to discuss the future instead of the present accomplishments. He stated his purpose to be a discussion of actual results, ignoring commercialism entirely.

Concerning detailed motor applications the author stated that individual motors are now used with notable success on pickers, with the advantages of subdivision of power, absence of shafting, better location of machines and localization of failures. In the latest work the motor has no shaft or bearings, but the rotating element is mounted on the beater shaft, the stator being attached to the machine by a bracket. This arrangement saves first cost, the motor shaft, coupling, two bearings and housing being omitted, and less space is required. In the card-room practically nothing has been done in the direction of the individual drive, largely on account of the low operating speed of the cards. Carding is practically a continuous operation. The use of direct drive on drawing frames has not been pushed. On fly frames the individual drive is coming into use on new work. Mule spinning is still a group-drive proposition. The group drive takes up the inequalities of power demand better than does an individual installation of motors. The ring frames present greater opportunities for individual driving than do any other machines used in the mill. Early driving by gears was rather crude and noisy. The directly-connected system now generally used has a motor shaft of sufficient length to extend within the cylinder, the end bearing of the latter being omitted, that on the motor serving for both. This drive is less expensive than one using gears, and far more satisfactory. The only objection is that it is impossible to spin a wide range of counts. Where a change in speed is needed the use of the silent chain drive is effective, combined with suitable pinion sizes at the motor. It is easy to keep this drive clean. The motor is controlled by a special switch connected with the shipper handle of the frame.

For those who appreciate the benefits of the electric drive, but wish to keep the cost down, the so-called four-frame drive is attractive. This equipment requires no shafting, and the motors are less in number and larger in size than with the individual system, thus effecting a considerable saving in first cost. The arrangement consists in mounting one motor on the ceiling with sufficient shaft extension on each end to accommodate two pulleys, four frames being driven by one motor. This plan eliminates nearly all the friction load and gives a fairly positive drive. The loss due to belt slip is confined to one belt for each frame. This drive allows better subdivision of power, improved control, steadier speed, absence of shafting, and is in every way an advance over the group drive. The cost is frequently less than with the group system using several large motors. The actual cost of both systems taken from a large mill just built, with 160 ring frames of 300 spindles each, where both were considered and the four-frame outfit installed, was as follows:

For the group drive bids were received from contractors covering shafting, pulleys, hangers, etc., delivered and erected To complete the drive five 150-hp motors were required on which bids were received. A combination of the lowest bids represented a cost of 22.4 cents per spindle for the 48,000 spindles required. With the four-frame drive it was decided to install 40 20-hp motors operating at 1150 r.p.m. The cost of these motors, delivered and erected, taken from the bids, was 18.9 cents per spindle, giving a saving of about $1,680 in the spinning frame equipment. If motors of 1700 r.p.m. had been used the saving of the four-frame drive would have been $2,300. This drive does not compare in efficiency, flexibility and increased productive capacity with the individual spinning frame drive; where spinning can be so arranged that certain frames are confined practically all the time to the same counts, the constant speed, direct-connected motor is far superior. Twisters are now being successfully operated electrically. Spoolers, warpers and cloth-room machinery still use the group system of drive.

Loom drive in cotton mills has been confined entirely to the group system owing largely to the number of looms required in a large mill and the cost of the direct drive. In velvet, silk, satine and worsted mills individual drive has been used to a large degree.

The largest textile installation in this country using motor drive makes use of a motor suspended in a cradle, the bottom of which is arranged for mounting directly on the floor under the driving pulley. The method of supporting the motor directly from the loom and driving through gear and pinion has been notably successful in silk, worsted and velvet mills. Marked increase of production results in both cases over the ordinary group system; lighter weave sheds are possible and the greater cleanliness is important, particularly in silk weaving.

In conclusion, the author gave some general figures for the first cost of power plants. A 2000-hp steam-turbine plant would cost about $100 per kilowatt, excluding land; a compound-engine plant would cost 20 per cent more, and a gas-engine plant complete, $95 per kilowatt. In general, the cost of the group drive with the larger motors runs from $7 to $8 per horse-power. Using individual motors of small sizes the cost rises to about $22 per horse-power. A successful motor of variable-speed characteristics will doubtless soon be produced for driving ring spinning frames.

Abstracts of other papers presented at the meeting will appear in later issues.

Dangers from Electric Headlight Glare.

Electric headlights, both on their own and on passing locomotives, as a menace to the view of engineers in seeing signals and obstacles ahead, were severely scored by Prof. Charles H. Benjamin, dean of the school of engineering of Purdue University, Lafayette, Ind., in a paper presented before the Western Railway Club at Chicago, April 19. Professor Benjamin's remarks covered the results of a series of tests recently conducted near Avon, Ind., under the direction of the Indiana Railroad Commission by the railway engineering department of Purdue University, at which officials of the New York Central and Pennsylvania lines were present and assisted. In these experiments a number of independent observers took their places in an inspection car which was run toward the home signals, stopping at intervals to allow observations to be taken. The series of tests included experiments in reading the signal at various distances, first with an opposing electric headlight on an adjacent track, 200 ft. in front of the home signal; then with an opposing oil headlight; with no opposing headlight; with an electric headlight on the observation car, and with an oil headlight on the car. The manipulation of the signals and obstacles on the track ahead was made independently by another division of the experimental corps, and the observers were instructed to record their observations without consulting among themselves.

As a result of these experiments it was found that an opposing electric headlight tended to obscure all signals, both those on the block towers and the classification signals carried by approaching trains. This interference was especially noticeable when any rain or fog was present. On the other hand, an oil headlight was found to obscure the various signals very slightly. With the electric headlight on their own car there were numerous instances of green lights being seen by the observers at short distances, when there was in reality no green light present. These phantom signals were probably due to light reflected back through the lens of an unlighted lamp, and were only noticeable with the powerful rays of the electric headlight. This phenomenon introduces an element of danger, in producing apparent safety signals where the real condition may be that of a danger signal extinguished. The observation of green rather than red phantom signals is explained by the prevalence of the short-wave lengths in the light from the electric head-lamp. This same effect of the electric arc was also seen in the greater obscuration of the green classification signals of passing trains.

Professor Benjamin believes that obstructions on the track cannot ordinarily be seen with an electric headlight to a sufficient distance to prevent the occurrence of accident. At the same time, an opposing headlight of this character, adjacent to block signals, so obscures them as to make it difficult to read them correctly at distances exceeding 100 ft. For opposing oil headlights, this distance was shown to be about 4000 ft.

In closing his remarks Professor Benjamin explained his conviction that the engineer and fireman of a train which carries an electric headlight are at a disadvantage in correctly reading signal lights, while on parallel tracks this objection is much increased, as the brilliant headlights from passing locomotives tend to obscure all signals. The greater illumination of the track ahead or of objects or obstacles thereon Professor Benjamin does not consider sufficient compensation for the disadvantages which his experiments showed for the electric headlight.

Massachusetts Commission News.

The Selectmen of the town of Plymouth have petitioned the Massachusetts Gas and Electric Light Commission to investigate the price and quality of electricity as sold by the Plymouth Electric Light Company. The board will give a public hearing on the matter at a later date.

The Shelburne Falls Electric Light & Power Company has requested the commission to approve the issuance of new capital stock amounting to $20,000 par value, at $100 per share, and to authorize the existing capital stock of $30,000 named in the company's articles of association, to be issued at $100 per share, for the purpose of raising funds to be applied in part to the purchase of the assets of the firm of Ernest J. Halligan and Charles H. Wilcox, doing business under the firm name of the Shelburne Falls Electric Light & Power Company, and in part to make further constructions, extensions and improvements in the plant and property.

The Gas and Electric Light Commission gave a hearing on April 18 upon the petition of the Lynn Gas & Electric Light Company for authority to purchase the Marblehead Gas & Electric Light Company. President Prichard, of the Lynn company, emphasized the economies and public benefits which would result from the purchase. The Marblehead company has never conducted an electric business, although legally authorized to do so many years ago. At present the town of Marblehead is supplied with electricity by a local municipal plant.

The Railroad Commission gave a hearing on April 21 upon the petition of the Northampton Street Railway Company for authority to establish a new schedule of fares on its lines for the purpose of raising more revenue from operation. Mr. L. D. Pellissier, treasurer of the company, submitted an exhaustive array of figures covering the operations of the road from 1893 to date, the data showing that the gross earnings had increased in this period from $32,359 to $175,277, and the operating expenses from $23,338 to $160,720. In 1893, when the road began electrical service, there was a net divisible income of $7,280 compared with a deficit of $14,465 for 1909. The company desires to resume original rates of fare by withdrawing the sale of reduced-rate tickets on the Williamsburg line and re-establishing the old fare limit between Easthampton and Northampton. Representatives of the various communities served by the company in general admitted before the board the need of additional revenue for the company, but preferred that it should be raised by fare increases in neighboring instead of local districts. The board took the matter under advisement.

A petition has been filed with the Railroad Commission by citizens of Rynham requesting the board to give a hearing upon an alleged discrimination in fares upon the lines of the Old Colony Street Railway Company. The Selectmen of Salisbury have petitioned the board to require the Haverhill & Amesbury Street Railway Company to repair and maintain that part of its roadbed and tracks between Black rocks and Salisbury Beach so that service may be rendered over that portion of the system. The Worcester & Southbridge Street Railway Company has petitioned the board for the right to carry freight and express matter in the town of Southbridge.

The Railroad Commission gave a hearing on April 20 upon the petition of the Dartmouth & Westport Street Railway Company for authority to issue new capital stock of $237,500 par value for retiring indebtedness and making additions to the company's property. President H. H. Crapo stated that the company desires to pay the funded debt, amounting to $90,000, and, among other purposes, to acquire land and erect an electric freight terminal station and car-storage house, make park improvements and add to the feeder system. The directors have fixed the price of the stock at $150 per share. There was no opposition, and the hearing was closed.

The Worcester Merchants' Association has petitioned the Railroad Commission to require the Worcester Consolidated Street Railway Company to carry freight and express matter.

The Railroad Commission gave a hearing on April 25 upon the petition of citizens of Jamaica Plain for the establishment of a station at Green Street, on the Forest Hills extension of the Boston Elevated Railway Company. It was contended that the combination of surface car and elevated service given in the district does not meet the requirements of the population. The company's case will be presented later, the general trend of its argument being that the cost of making the extra stop and the lengthening of the running time involved do not warrant the construction of the station.

Massachusetts Legislative News.

The committee on ways and means has reported that the bill relative to the increase of salaries of the Gas and Electric Light Commissioners ought to pass with an amendment fixing the annual salary of the chairman at $5,000 and of the other members of the board at $4,500 each. The bill making street-railway companies liable for the safety of passengers riding in car vestibules has been passed by the House to be enacted. Several additional petitions relative to the authorization of the New York, New Haven & Hartford Railroad Company's proposed acquisition of electric railways in the Berkshire district of the State have been received and referred to the committees on railroads and street railways, sitting jointly. Public sentiment appears to be almost unanimously in favor of this development in western Massachusetts, as the company stands ready to expend $2,000,000 in electric transportation extensions and improvements if a law is passed allowing it to take over the trolley lines west of the Connecticut River and co-ordinate them with its own system. The Senate has received a petition for legislation to authorize the Greenfield Electric Light & Power Company to do business in the towns of Shelburne and Buckland. The engrossed bill exempting the transit bonds of the city of Boston from the provisions of law relative to Boston loans has been passed by the Senate to be enacted. The Senate has accepted the recommendations of the committee on public lighting referring to the next Legislature the bills prohibiting or regulating charges for the use of gas and electric meters. The committee on street railways has presented an adverse report upon the bills reducing the hours of labor of street-railway employees, and the same committee has submitted a bill authorizing the Shelburne Falls & Colraine Street Railway Company to refund its funded debt and fund its floating debt. The bill permitting the purchase by street railways of the property of foreign companies has been passed by the House to be enacted. The House has defeated an attempt to reconsider the Henebery bill authorizing the authorities of municipalities to grant limited freight and express carrying franchises to street railways, without recourse to the Railroad Commission's jurisdiction, the vote being 110 to 91 against reconsideration. The House has amended the bill relative to the provision of reduced fares for schools of certain kinds by substituting a bill providing that half fares shall be granted by street and elevated railways to pupils of normal schools. Business college pupils are not entitled to reductions in fares under this action.

New York Public Service Commission News.

The Public Service Commission of the First District of New York advertised last week in the *City Record* the public hearings on the forms of contract for new subways which were referred to in our last issue. These hearings will take place on May 9 and 16. If any suggestions are made at them which the commission deem pertinent, the contracts will be altered accordingly and will then immediately be sent to the corporation counsel for his approval. The contract, providing construction by private capital, provides that the construction and equipment shall be paid for entirely with the contractors' capital, but that the title to the property shall at all times rest with the city. The consideration to the contractor is the operation privilege for a term of years sufficient to amortize the capital issued and one-half the operating profits over and above all fixed charges, the city getting the other half. The contract is indeterminate and the city may take over the property at any time after 10 years by the payment of the actual cost of construction and equipment and a contractors' profit of 15 per cent additional. The bids are asked not upon the basis of cost, but upon the brevity of the term of operation which the contractor demands. Work must be commenced within 60 days of the execution of the contract and the line must be ready for operation within four years. A board of arbitration is provided consisting of one engineer appointed by the commission, one by the contractor and a third by the executive committee of the Chamber of Commerce.

President Willcox, of the commission; Mayor Gaynor, and Theodore P. Shonts, president of the Interborough Rapid Transit Company, held an extended conference last week in an endeavor to agree upon a basis on which the Interborough Company would build extensions to its subway system and place in service the Steinway Tunnel. If any compromise plan was agreed upon, it has not been made public. It is said that the Mayor insists that if the Interborough company is given the rights which it seeks of third-railing the east side elevated lines and building a downtown subway under Seventh Avenue and an uptown subway under Madison Avenue, it must also agree to operate the Steinway Tunnel on a single-fare basis and agree to build the projected East River tunnel into Brooklyn which is known as the Pineapple Street Subway.

A delegation of citizens of Brooklyn, headed by Charles A. Schieren, former Mayor of Brooklyn, has presented a petition to the Public Service Commission urging the construction of another subway and tunnel connecting that city with the lower end of Manhattan. The suggestion is made that Maiden Lane be about the proper place for such a line to terminate in Manhattan.

The hearings upon the reorganization plan of the Third Avenue Railroad Company before the Public Service Commission are nearing a conclusion. The figures offered by the commission's engineer, E. G. Connette, and those embraced in the application which were prepared by the company's engineer, are very near together. It is believed that a basis of agreement will be soon reached.

The commission, last week, held its final hearing upon the application of the Manhattan Bridge Three-Cent line for certificate to operate from Flatbush and Fourth Avenues, Brooklyn, to West Street, Manhattan, across the new Manhattan Bridge and through Canal Street. After the commission acts upon this application it will be necessary for the Board of Estimate to grant the franchise.

The Public Service Commission, Second District, has authorized the East Creek Electric Light & Power Company to make a first and refunding mortgage upon all its property, estates and franchises to the New York Trust Company to secure the payment of $3,000,000 of 50-year 5 per cent bonds. The company is authorized to issue at present $1,750,000 in bonds at not less than 85, proceeds to be used to retire outstanding bonds, the payment of obligations, the purchase of additional lands and water power, new power plant and additions generally to its property. The company is authorized to increase its capital stock from $200,000 to $500,000 and to issue the additional $300,000 of stock for the payment of moneys advanced, organization expenses and the purchase of additional lands for East Creek development. The East Creek Company is now engaged in generating electricity at its power plant in East Creek and selling and distributing the same at St. Johnsville and also in selling and distributing electricity at Fort Plain, Nelliston, Canajoharie and Palatine Bridge for public and private use.

Recently the company was requested by the Fonda, Johnstown & Gloversville Railroad Company to provide a large amount of electricity for lighting and heating purposes and the railroad company has informed the electric company that it will enter into a contract for approximately 7500 hp. The East Creek company also believes there is a market for a large amount of electric energy in the cities of Johnstown, Gloversville and Amsterdam, which market it can readily serve.

Among the plans of the company are the development of additional water power on East Canada Creek at Inghams Mills. It is stated that the East Canada Creek is capable of being developed to an extent sufficient to produce 15,000 hp and that it is also possible with proper improvement to develop an additional 15,000 hp at the present power station of the company.

CURRENT NEWS AND NOTES

Doherty Medal for the N. E. L. A.—Past-President Doherty, of the National Electric Light Association, has founded a gold medal to signalize the twenty-fifth anniversary of the association. It is proposed that the medal shall be awarded for the best paper presented before the sections. The details of the plan, which have not yet been decided upon, are being worked out by Past-President Eglin.

N. E. L. A. Membership.—During the month from March 12 to April 12 the membership of the National Electric Light Association increased from 4776 to 5192, a net gain of 416. The gain since July 1, 1909, is more than 2000. It is expected that the total will reach 6000 before the close of the forthcoming convention in St. Louis. Among the membership are several women connected with the central-station industry.

Conservation Bill.—The United States House of Representatives has passed the bill authorizing the President to make withdrawals of public lands for purposes of conservation. The bill was finally passed in practically the same form in which it came from Mr. Ballinger, Secretary of the Interior. It authorizes the President to submit to Congress recommendations for legislation affecting withdrawn land. It also requires the Secretary of the Interior to report to Congress all withdrawals and the purpose thereof.

Energy for Palestine from the Jordan.—According to advices from London, plans are being made for supplying the whole of Palestine with electricity for lighting, heating and cooking purposes. The energy will be obtained from the falls of the Jordan, between the Waters of Merom and the Lake of Galilee, where the river descends 700 ft. A generating plant will be erected on the west bank of the river, and will be connected with all the chief towns of the country. Some $1,000,000 will be required for the initial expenses. The enterprise will be financed in Paris.

Webster Grove Switching Station Burned.—On April 15 fire destroyed the Webster Grove switching substation of the Suburban Electric Light & Power Company, which supplies electrical service to the south part of St. Louis County, Mo., including an important suburban territory adjoining the city of St. Louis. The Suburban company purchases energy from the lines of the Union Electric Light & Power Company, of St. Louis, and will not be seriously embarrassed by the loss of its small switching plant, as new and additional equipment had already been ordered, though fortunately this was not installed at the time of the fire.

N. E. L. A., St. Louis Branch.—The first regular meeting of the Union Electric Light and Power Company Section of the National Electric Light Association was held in the general offices of that company on Friday, April 22, when the constitution and by-laws were adopted and an executive committee elected by the new organization. A paper entitled "Obligations Imposed by the Possession of a Franchise" was read by Mr. Alten S. Miller, president of the Union company, the subject being afterward thrown open to general discussion by the audience. The membership of the St. Louis branch has already reached 200, and is taken from all departments of the electrical organization of the company.

Depreciation and Reserve Funds of Electrical Properties.—A paper on "Depreciation and Reserve Funds of Electrical Properties" was read by Mr. William B. Jackson before the Western Society of Engineers, Chicago, on April 27. The author divided depreciation into two parts, decrepitude and obsolescence. The term reserve fund, as discussed, was also divided so as to cover two purposes: First, required deconstruction, arising from municipal or other legislative requirements; second, special insurance, to cover such expenses as result from great conflagrations, etc. Mr. Jackson stated that a goodly proportion of the failures of electrical properties in the past may be traced to a lack of provision for depreciation expenses and for extraordinary expenses.

Joint Telephone Convention.—The Toll Line Clearing House Associations of Indiana and Michigan, connected with the Independent Telephone System, will meet in South Bend, Ind., May 11, when the State telephone associations of Indiana and Michigan hold their joint convention May 11 and 12. It is expected that 300 representatives of the Independent telephone movement from the two States will be present. The president and the former president and other officials of the National Association will be present. Matters of importance in the way of local service in the two States will be discussed and it is believed the situation in Indiana relative to the Morgan interests will be analyzed. The headquarters will be in the Oliver Hotel, where a banquet will be held on the evening of May 11. Mr. Theodore Thorward, president of the South Bend Home Telephone Company is in charge of the arrangements.

Toronto Municipal Plant.—The city of Toronto is busily engaged in completing its municipal electric lighting system, preparatory to receiving electrical energy from the Hydro-Electric Commission over a line being built between Ontario and Niagara Falls. The present street lighting contract will expire Dec. 30, and it is expected to have the entire municipal system completed by that time. The system, which will cost $2,750,000, will include five substations and an underground distributing system. A contract has been made for 6600 hp of electrical power, of which 4000 hp will be supplied to the water works, 3000 hp for street lighting and 600 hp for other city purposes, a total of 6600 hp. It is expected that the total requirements will eventually be 10,000 hp. The power will be delivered at 110,000 volts to the receiving substation at which the e.m.f. will be reduced to 13,200 volts for distribution to distributing substations.

Wisconsin University Summer Schools.—The tenth annual session of the Summer Schools for Engineers and Artisans, under the direction of the College of Engineering of the University of Wisconsin, opens June 27, continuing for six weeks. Advanced courses are offered in direct and alternating currents, hydraulics, machine design, descriptive geometry, applied mechanics, shopwork, steam and gas engineering and surveying. Elementary courses for artisans, and those not having preparation for the advanced work are offered in applied electricity, engines and boilers, fuels and lubricants, mechanical drawing, machine design, materials of construction and shopwork and surveying. The teaching staff is taken from the regular instructional forces, and all laboratory equipment of the engineering college is available for students. Bulletins or further information may be obtained by addressing Dean F. E. Turneaure, College of Engineering, Madison, Wis.

Prof. R. B. Owens Appointed Secretary of Franklin Institute.—Prof. R. B. Owens has been appointed secretary of the Franklin Institute, Philadelphia, to succeed Mr. James Christie, resigned, who in turn succeeded the late Mr. Wm. H. Wahl, who occupied the position for a generation or more. Professor Owens, after graduation from the Charlotte Hall Military School, Maryland, joined the Baxter Motor Company and was engineer of its New York office in 1887. In the latter year he entered Johns Hopkins University, where he followed the electrical course for two years. After a year with the Excelsior Electric Company and while managing a central-station plant, he took a post-graduate course at Columbia University and received the degree of E.E. in 1891, the first year in which this degree was awarded in this country. In 1891 he was appointed professor of electrical engineering in the University of Nebraska, which he resigned in 1898 to accept a similar chair at McGill University, where he remained until last year. Recently Professor Owens has been on the engineering staff of the Southern Power Company.

New Copenhagen Central Station.—The City of Copenhagen, Denmark, will add to its present central-station equipment an alternating-current station with a capacity of 180,000 hp.

Telephone-Telegraph Banquet.—The officers of the American Telephone & Telegraph Company tendered a dinner to the officers of the Western Union and Bell companies at the Hotel Astor, New York, on April 18. The officials of both companies were present, about 60 in all being in attendance.

Central Station Libel Suit.—The Sheboygan (Wis.) Light, Power & Railway Company has entered in a suit against a newspaper of that city for libel. The newspaper charged that the company was furnishing 500-cp lamps when 1000-cp lamps were contracted for, carrying on systematic swindling in this manner.

Cooling Towers in Edinburgh.—The city of Edinburgh, Scotland, proposes to erect three cooling towers in connection with its municipal electrical plant. The towers will be of ornamental pattern, and will lead to a large saving in fuel and allow the output to be increased in the proportion of 7½ to 11.

Rose Polytechnic Students Visit Chicago.—The senior class of Rose Polytechnic School, at Terre Haute, Ind., spent part of the week ending April 23 in visiting the electrical properties, factories and freight tunnels of Chicago. The trip closed with a banquet at the Engineers' Club Saturday evening, at which a number of prominent business men delivered addresses.

Florida Electrical Association.—At the close of the convention of the Florida Electric Light and Power Association in Tampa on April 13 the following officers were elected: President, Mr. Fred Fletcher; vice-president, Mr. W. C. Bostick; secretary-treasurer, Mr. H. C. Adams; directors, Messrs. J. H. Scales and E. C. Bennett. The next convention will be held in Jacksonville.

Water Pumping at Ellsworth, Wis.—On page 1010 of the *Electrical World* of April 21 a short article appeared regarding cost of water pumping, which gave figures on the watt-hours per 1000 gal. required for pumping city water from a deep well at Ellsworth, Wis. By a misprint the total lift was given as 40 ft. when it should have been 400 ft. The watt-hours per 1000 gal. were 2062 under these conditions, the entire lift being with a single deep-well pump.

London Department Store's Telephone Offer.—Selfridge's, the American department store in London, has offered to have a telephone installed in any business or private house and pay 10 per cent of the first year's charges. The order is given direct to the telephone company, who by an arrangement with Selfridge's will make the 10 per cent reduction in bills. The company says it looks for its return in the business that will result and in the publicity received.

Appointment of United States Wireless Engineers.—The United States Civil Service Commission will hold an examination on June 1 to fill two vacancies in the position of wireless engineer, at $2,000 per annum each, in the Philippine Bureau of Posts. A circular may be obtained from the office of the commission, Washington, D. C., giving details as to the examination. An examination will also be held on the same date to fill three vacancies in the position of wireless telegraph operator, at $1,200 per annum, also in the Philippine Bureau of Posts.

Farm Wind-Mill Electric Plant—A wind-mill and storage-battery lighting and power plant has been installed by Mr. J. F. Forrest on his farm near Poynette, Ind. The battery will store sufficient electrical energy to run the lamps, of which there are 20, for a week. Besides supplying the electric lamps, there are electric motors for running a drill press, a small rip saw, the grindstone, the corn sheller and to grind feed, buckwheat, flour and cornmeal. The electric plant was installed entirely by Mr. Forrest, who also wired the building and set up the batteries alone.

Kinloch Company Upheld in Automatic Telephone Ringing Litigation.—The United States Circuit Court for the Eastern District of Missouri handed down a decision on April 19, dismissing the bill in the case of Angus S. Hibbard, complainant, against the Kinloch Telephone Company, of St. Louis. This action was based on United States patent No. 542,052, granted to Mr. Hibbard. This patent is for an automatic telephone-ringing system, and it was alleged that the Kinloch company infringed claims Nos. 7 and 8. The defendant's counsel, Brown & Williams, of Chicago, contended that unless limited to the specific details set forth in the Hibbard patent in suit, the claims are anticipated by the prior act, and particularly by the Von Orth patent. The suit was an important one and the Independent telephone interests consider the dismissal of the bill of complaint a notable victory.

Pittsburgh Meeting of the A. E. S.—The American Electrochemical Society will hold its general meeting at Pittsburgh on May 4, 5, 6 and 7. Papers dealing with electric furnaces will be presented by Messrs. Carl Hering, C. J. Reed, K. C. Randall, A. L. Queneau, P. L. T. Héroult, T. Rowlands and R. S. Wile. Electrolytic processes will be discussed in papers by Messrs. C. C. Cito, H. M. Goodwin, E. M. Chance, W. O. Snelling, M. Thompson, H. E. Patten, W. J. McCaughey, C. F. Mathers and J. Whiting. Measuring instruments for electrochemical processes will be treated by Messrs. D. L. Ordway and C. E. Foster. Other subjects to be dealt with are: "The Effect of Moisture and of Solution Upon the Electrical Conductivity of Soils," by Mr. R. E. O. Davis; "The Electrochemical Potentials of Calcium-Aluminum Alloys," by Mr. James Breckenridge; "A Rotating Graphite Anode," by Mr. J. W. Turrentine; "The Determination of Copper," by Mr. F. C. Frary and A. B. Petersson; "The Townsend Cell," by Mr. H. K. Richardson and R. L. Patterson. Addresses of general interest will be made by President Baekeland, Secretary Richards, Dr. J. A. Brashear and Mr. J. H. Finney. The society headquarters will be at the Fort Pitt Hotel.

Utah Light & Railway Company to Replace Poles with Steel Towers.—On its lines between Ogden and Salt Lake the Utah Light & Railway Company will replace its present poles with structural steel towers. The latter will be 60 ft. high and will give a span of 600 ft. The towers will carry the double three-phase transmission line, consisting of six No. 0 standard hard-drawn copper wires; two ⅜-in. steel cables for lightning protection and one No. 4 steel-wire telephone circuit from the Pioneer station in Ogden Canyon to the Jordan station in Salt Lake, a distance of 39 miles. The Utah Light & Power Company is now installing similar steel towers on the high-tension line from the station in Weber Canyon, at Devil's Gate, to the intersection of the line from Ogden to Salt Lake.

Montefiore International Electrical Prize.—The late founder of the Institut Electrotechnique Montefiore of Liege, Belgium, left a sum of 150,000 francs, of which the triennial proceeds, about $2,700, is to be awarded every third year for the best original work on the scientific advancement and on the progress in the technical applications of electricity in all of its branches, books in the nature of popular treatises or simple compilations to be excluded. The prize, known as the Foundation Georges Montefiore, is open for international competition and will be awarded by a committee consisting of five Belgians, including the director of the Institut Montefiore, and five electrical engineers from other countries—all members to be graduates of the Institut. The first award will be made in 1911, and consists of 20,000 francs. Further particulars may be obtained from Monsieur O. Bast, 31 Rue Saint Gilles, Liege, Belgium.

Colorado State Control of Water-Power Sites.—The Colorado Conservation Commission, in session at Denver on April 19, adopted a resolution declaring for exclusive State control of water-power sites.

Central-Station Energy for Gary & Interurban.—The Gary & Interurban Railway Company, connecting Gary and Hammond, Ind., with principal office in Chicago, has entered into contract with the North Shore Electric Company to purchase 500 kw of electrical energy, with the privilege of taking 1000 kw, delivered at the State line between Indiana and Illinois, at a point east of Bernice, Ill. The railway company will have a substation near Gary, and will take its entire supply of electrical energy from the central-station company. The electricity will be delivered as 12,000-volt 60-cycle current.

Underground Wires Proposed in Jamestown, N. Y.—The Park Commission of Jamestown, N. Y., appointed a committee some time ago to investigate the feasibility of establishing an underground-conduit system for the telephone, telegraph and electric light wires in the business section of the city. Conferences have been held with representatives of contractors for underground work, and it is figured that three or four miles of conduit will be needed. The plan contemplates ownership by the city, which will be reimbursed by rentals received from various electrical companies. The total cost of establishing a conduit system in Jamestown, within the area included in a radius of half a mile from Main to Third streets, will be about $40,000. After detail figures have been received, the park commission will make a report to the Common Council, with recommendations.

One Chicago Railway Rehabilitation Period Ended.—The 3-year "immediate rehabilitation" period of the Chicago City Railway Company under the traction "settlement ordinances" came to an end on April 15. The provisions of this company's ordinance in relation to the "immediate rehabilitation" of its system have been carried out with success, entailing an expenditure of $17,507,294. The Chicago Railways Company did not accept its ordinance until later, so that its rehabilitation period will not expire until January 28, 1911. Mr. B. J. Arnold will continue as chairman of the Board of Supervising Engineers, but his supervision of the construction work of the Chicago City Railway as chief engineer of the board has now ceased. From now on the Chicago City Railway Company will set aside 6 per cent of its gross earnings for maintenance and repairs, and 8 per cent for renewals and depreciation.

Marshall Field & Company Will Give Electric Vehicles Another Trial.—Marshall Field & Company, the well-known merchants of Chicago, have ordered four electric delivery wagons which will operate from a distributing center on the South Side. At the company's warehouse on Cottage Grove Avenue near Forty-seventh Street a charging station has been built. This consists of four 40-amp mercury-arc rectifiers, with the necessary meters and instruments, and a special terminal and junction box. At this garage the four new cars, which are being built by the Automobile Maintenance Company, of Chicago, may be charged at one time. This order of Marshall Field & Company for electric wagons is of unusual interest, because the same firm experimented with electric vehicles several years ago, but gave up the attempt as unsuccessful. Meantime, the art of building and maintaining electric automobiles has advanced rapidly, and the merchandising concern has been persuaded to give vehicles of this type another trial.

Curious Interruption to Service at Gary Steel Plant.—Several mysterious interruptions to the electric service in the large plant of the Indiana Steel Company at Gary, Ind., occurred a week or so ago. These steel works are to a large extent operated by electricity generated on the premises by a very large gas-engine plant, although an emergency connection for an outside supply of electrical energy is also provided. In seeking to determine the cause of the trouble, one man, said to be the night foreman of the power plant, was particularly zealous. One evening this man was found unconscious at the entrance to the concrete tunnel in the basement of the power house. When revived, he declared that he had solved the mystery, and that his injury had been caused by an intruder whom he had found meddling with the electric plant. Investigation is said to have proved, however, that the injured man himself was the meddler. The trouble was caused by short-circuiting the busbars by a piece of iron pipe, and the mischief maker is believed to have struck an iron beam in hurriedly emerging from the tunnel, fracturing his skull. No serious damage was done to the plant, although the trouble caused the steel company some delay and annoyance. No motive is ascribed for the deed, and the sanity of the man who perpetrated it, who is now in the hospital, is questioned.

Sons of Jove Preparing for Rejuvenation at St. Louis Convention.—One feature of the coming annual convention of the National Electric Light Association to be held in St. Louis May 23-28 that will be sure to attract attention will be a rejuvenation of the Sons of Jove. This ceremony will probably be held on the evening of Tuesday, May 24, and it is believed that there will be no other convention attraction on the evening of that day to interfere with it. The St. Louis Jovians have appointed the following committees to have charge of the affair: Finance, Messrs. Fred Johnson, of Wagner Electric Manufacturing Company; Fred B. Adam, of Frank Adam Electric Company, and John P. Casey, of Commercial Electric Supply Company. Arrangements, Messrs. Sam A. Hobson, past Jupiter, of Wesco Supply Company; L. F. Philo, of Western Electric Company, Milton Mill, of National Metal Molding Company, and James J. Mullen, of Moloney Electric Company. It is planned to have delegations of Jovians on the convention trains going to St. Louis, and the solicitation of candidates for membership will be conducted during the railroad journeys from the various centers. It is hoped by this means to secure a hundred candidates before reaching St. Louis, and it is expected that the St. Louis Jovians will secure an equal number before and at the convention, so that the number of new members to be initiated may be about 200. It is planned to make this rejuvenation one of the most successful in the history of the order.

An Electrical Theory of Dyeing.—In a paper presented before the Faraday Society, in London, on April 5, by Messrs. W. W. Haldane and William Harrison, much valuable experimental data were presented to substantiate the electrical theory of dyeing. The electrical theory may be stated as follows: Suppose the dye to be basic and represented by $n—P$, where n is a small negative ion and P a large positive basic ion. These ions will be free, and when wool or silk is placed in the solution the basic ions will be attracted by the negatively charged fibers and be fixed by some process which is not yet properly understood. The small ions will combine with the H ions present in the so-called double layer. If inorganic electrolytes are also present in the solution, and are of an alkaline nature, they will tend to make the fiber still more negative, and will assist the process of dyeing. In the case of acid dyes they deal with substances of the nature $p—N$, where p is now a small positive ion and N a larger negative ion. In this case acid is either added to the bath or the fabric has been previously boiled with acid. In each case the fiber takes a positive charge. The result will be that N will be attracted by the positively charged fiber, while p will form a salt in the vat. A strong confirmation of the theory is afforded by the amount of absorption of dye stuffs at different temperatures. Brown has shown that with basic colors the maximum amount of dye stuff is absorbed at about 40 deg. C. and the minimum at about 80 deg. C. The authors' results show that the maximum negative charge is attained at about 40 deg. C. and the minimum at about 80 deg. C.

AN ARC LIGHTING SUBSTATION.

Motor-Generator Substation for Arc Lighting System in Milan.

By M. Stoppoloni.

In 1896 the Edison Company of Milan, at that time representing the General Electric Company, of Schenectady, obtained the contract for the illumination of the streets of Milan by arc lamps.

For this purpose they employed four units, each unit consisting of a three-phase induction motor directly connected to two Thomson arc dynamos, one at each end of shaft. The lamps used were the Thomson series open arc lamps.

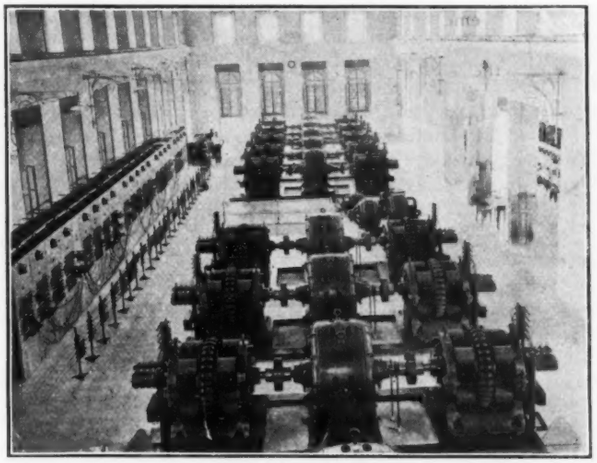


Fig. 1—Machine Room.

In 1905, at the end of the contract with the Edison Company, the Milan municipality took over the street lighting. At that time there were 300 lamps in use. The Milan municipality made extensive experiments with other methods and other types of lamps, after which they decided to continue the system and to use same arc lamps as had been used by the Edison Company.

As the city has grown immensely during the last few years, new streets have been made and more light is required, so that the lamps which in 1905 numbered only 300, now, in the beginning of 1910, number 1500.

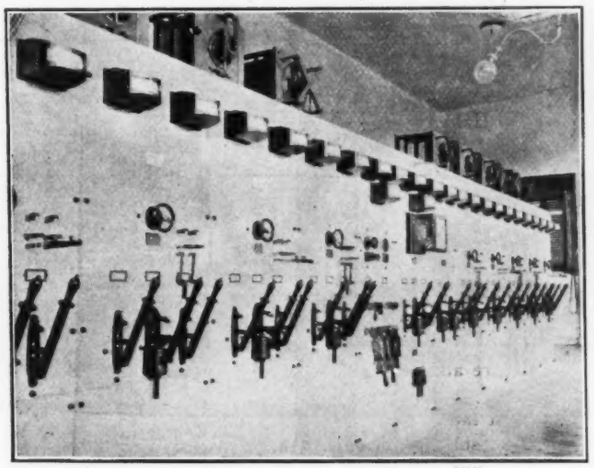


Fig. 2—Switchboard for Incoming Feeders.

When the municipality first took over the street lighting and installed more lamps, they bought four units, each composed of a three-phase synchronous motor of 270 hp at 8500 volts, 42 cycles and 500 r.p.m., driving at each end of the shaft by means of flexible couplings; two Brush arc dynamos each giving 8000 volts and 9.6 amp.

With the increased requirement of more light, the municipality decided to build a special substation for the street arc lighting only. This substation, which was started in 1908 and finished at the end of 1909, is worthy of more than passing casual attention. Great care was taken in making it a model substation in every particular.

The substation building besides the machine room contains offices for the engineers, a drawing office, a well-furnished laboratory, workshop and stores.

The machine room has the floor raised about four feet above the ground and is paved with white and gray tiles, the walls are all of white tiles. There are 10 units, each composed of a synchronous motor and two Brush dynamos as above described.

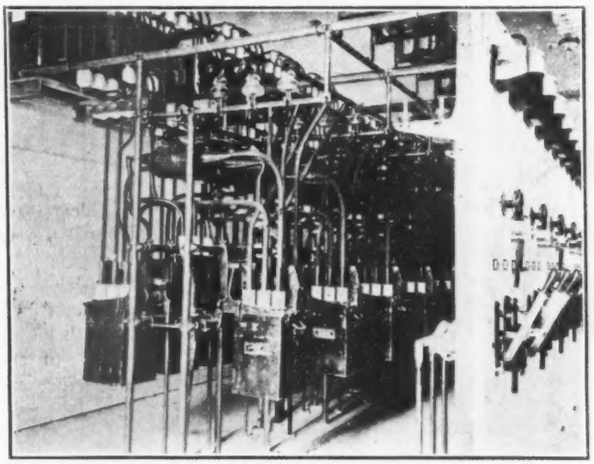


Fig. 3—High-Tension Wiring and Switches.

The machine room also contains two continuous-current dynamos of 150 kw each at 115 volts and 505 r.p.m., driven through an elastic coupling by a 225-hp induction motor operating at 160 volts and 42 cycles. These machines serve as exciters for the synchronous motors and Brush machines. In addition to the above equipment there are two of the old units first used by the Edison Company. These two units are still used on small secondary circuits, and although they have been in use for 14 years they still work well. The other two units of the Edison equipment are used in the laboratory for arc lamp testing.

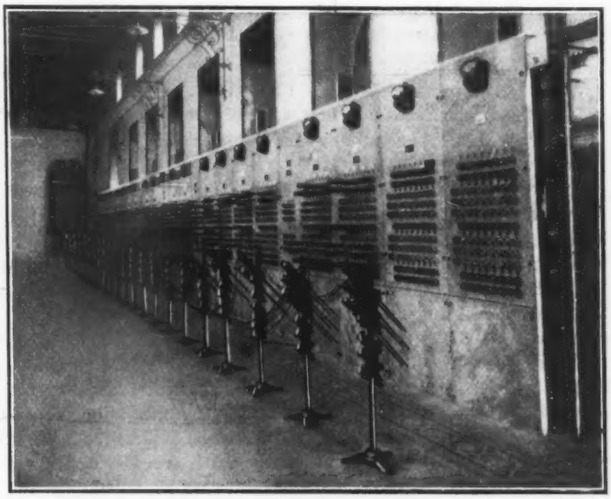


Fig. 4—Arc Circuit Panels.

In the basement there are four 8500/110-volt, single-phase, air-cooled transformers for the motors of the exciter sets and for the motors of the Thomson arc dynamo set. One of the transformers is kept as reserve and can be switched onto any one phase.

The synchronous motors of the main units are started as asynchronous motors at half voltage, obtained by means of compensators, and full voltage is switched on when they have reached synchronous speed, which takes about 1.5 minutes. For starting there are three oil switches per motor, one oil switch to connect the compensator to the line, one between the compensator and motor, and the other, the main switch, between the line and the motor.

The Brush machines are each capable of lighting 160 arc lamps, which are divided 40 in series on each one of the four circuits of the Brush dynamo, each circuit is at 2000 volts, 9.6 amp.

The great advantages of having the lamps in series are, in the first case, that they need not have any regulating resistances,

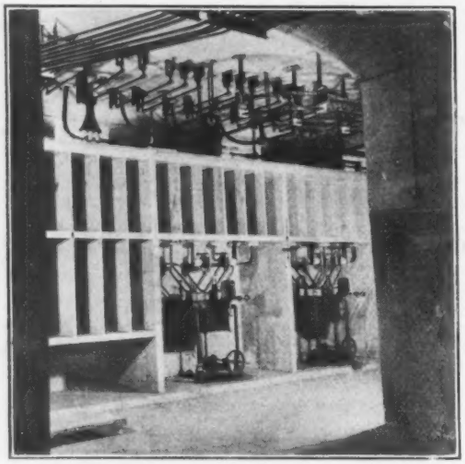


Fig. 5—Switch Compartments.

as they tend to balance one another; and secondly, and this is of great economical interest, that there is a great saving in copper on the whole outlay, specially when long distances are to be covered, as is here the case, there being lamps at about 1.87 miles distant from the substation in one direction and 1.6 miles in another direction almost opposite. In lighting with arc lamps in series the function of the dynamo is to keep the amperes constant with the number of lamps, the lamps being furnished with a shunt device which commands the movement of the carbons and keeps the voltage constant at the lamp terminals.

The Brush arc machines are self regulating, as each one is provided with a rheostat and regulator. The regulator performs two operations, increases or decreases the resistance in shunt with the field circuit, and rocks the brushes so that the spark is kept at proper length, varying from ⅛ in. at full load to ⅜ in. on short circuit. The regulator works from the shaft by means of a small belt.

The Brush machines and synchronous motors are thoroughly and permanently insulated from earth, being mounted on a dry-wood base of about 10-in. thickness.

There are two switchboards in the station, one on each side of the room, both made of blue Vermont marble. One of the switchboards, as shown in Fig. 2, is for the incoming feeders and synchronous motors; this board has on its face only ammeters, voltmeters, a watt-hour meter, small lever switches for the motor field circuits and handles of the oil switches. On the board there is only low-tension wiring. All the oil switches, high-tension wiring, series instruments, transformers and compensators are behind this board some 2 ft. distant, on an iron tubing framework, all the wiring being insulated from framework by means of glass insulators (Fig. 3). The design and assembly of this board have been very well studied and carried out so that every part is readily accessible.

The other board is for outgoing lines from the Brush machines; the switches are all of the plug type, of new design and safe to handle. The marble panel is not relied upon for the insulation, as each switch is insulated from the panel by porcelain bushings. These porcelain bushings not only completely insulate the live parts from the panel, but also prevent anyone from coming into contact with the live parts of the switches.

Transferring is accomplished by means of buses on the back of the panel, thus avoiding the confusion and danger of handling transfer cables. Cables are used only in extreme cases of transfer, and all cable plugs are constructed so that the cable enters the plug below the handle, making it unnecessary to touch the cable while shifting the plugs.

There is only one ammeter per machine, the scheme of using one ammeter for a number of circuits is accomplished by means of a bus ammeter jack. There are two ammeter jacks for each circuit that the panel controls, but only one ammeter jack plug is provided for each ammeter. By inserting this plug in any ammeter jack, the ammeter is thrown in series with that circuit. Ammeter jacks are furnished on each side of a circuit to facilitate testing for grounds. A leakage current to the ground will show a difference of reading when the ammeter is plugged into the different sides of the circuit.

The porcelain bushings also serve another purpose, in order to distinguish between the various switches on the face of the board, bushings of different colors are used.

In the station all the wiring from switchboards to machines, except the high-tension cables going to motors, to outgoing feeders and to lightning arresters, by which every circuit is protected, is done in thin steel tubing internally insulated and makes a very neat job (Fig. 6).

The substation at present receives energy at 8500 volts, by means of armored underground cable, from the steam central station of the municipality, which is close to Milan, and which is equipped with steam turbines having a total rating of 12,400 kw; the rating of this station is being raised to 18,000 kw by the addition of another steam turbine. It may here be remarked, to show the increased demand for energy, that in the last year the return from energy sold to private parties has gone up from $200,000, at the end of 1908, to $310,000, at the end of 1909.

The municipality is at present constructing an hydroelectric

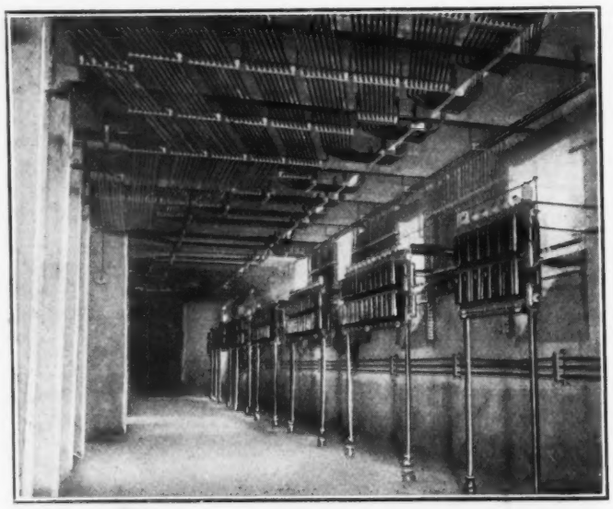


Fig. 6—High-Tension Wiring.

station of great importance at Valtellina, which will in time take over the greater part of the load at present on the steam central station at Milan.

The feeders coming from the central to the substation are composed of three-core armored cable, and are laid in a wooden duct covered with pitch, the same as a part of the outgoing feeders.

The high-tension lines coming to the substation go direct to busbars, in the basement of the substation, which are divided into two sections by means of sectionalizing switches. There is also another set of sectionalizing switches in the basement,

close to the busbars, between the busbars and each motor oil switch, each set being contained in an imitation stone cell.

The greater part of outgoing feeders are supported by iron brackets on the walls of the houses, just below the roof, and as all the lamps in the streets are suspended on transversal suspensions, the wire runs down the wall of the house, along the suspension to the lamps and returns by the same way.

In the squares and parks the lamps are on poles of the usual type, and the feeders are underground.

The substation lighting is done by means of metal filament lamps on an alternating current circuit, the low tension being obtained from a small transformer on one phase. In case the current on the line should fail, current from a battery of accumulators is mechanically switched onto the lamps.

The battery, which is small, being only for 40 amp-hours, is in a room in the basement, and only used in special cases for lighting the station, and is chiefly used for the laboratory.

The maintenance of the whole system is fairly cheap; the substation is only in service during the night, that is, from about 6:30 p. m. to 6 a. m. in the winter and 8 p. m. to 3 a. m. in the summer, after midnight there are only half the number of lamps burning.

The substation staff consists of one engineer, two switchboard attendants, four helpers, one storekeeper, two skilled workmen for lamp repairs, four workmen for general repairs and 11 laborers. Besides these there are 22 arc lamp attendants. Each lamp is visited once daily.

All the machinery and switchboard material was supplied by the General Electric Company, of Schenectady, and the cables by the Pirelli Company, of Milan. The erection of the substation was all carried out by the municipality's staff.

ELECTRICAL TRANSMISSION OF MUSIC.

Developments in the Cahill Telharmonic System.

OUR readers are familiar with the general features of the Cahill Telharmonic system for generating currents of the proper frequency and amplitude at a central station, and superposing and transmitting them to numerous distant points, for the purpose of producing music by means of electromagnetically vibrated diaphragms. During the past three years important changes have been introduced in the equipment, and the results now being obtained with a new and larger plant, which is being completed in the Cahill laboratory at Holyoke, Mass., are even better—in some ways strikingly better—than those secured with the equipment formerly in service in New York City. The power and breadth of effects and the range of expression have been greatly increased. The mechanism has been simplified and the keyboard can now be manipulated by any skilled pipe-organ or piano player after only a few trials, with results much more pleasing than they can obtain with the instruments upon which they have spent years in study and practice.

But, notwithstanding this, the instrument has a new technique, a thorough mastery of which is not easily obtained. A well-known musical critic puts it thus: "Any good pianist, with a few hours' practice, can produce some very pleasing effects on the new Telharmonium. But it would take a great musician 10 years to master thoroughly its technique."

A description of the electrical features of the New York equipment was contained in our issue for March 10, 1906, and Jan. 5, 1907. In the present article will be given an outline of the more interesting of the improvements that have been introduced in the new equipment.

Before taking up the improvements in detail it may be of interest to the reader to know what was desired in building the new plant. The ability of the New York plant to produce a wide range of orchestral timbres and to control the loudness of the note at every instant, by the human touch, are known to all who saw and heard it or to those who have read the previous descriptions in this journal. But it fell short of the inventor's ideal in ways that will be understood from the explanation below.

In the New York plant, each switchboard represented a voice, but to produce the full, rich, many-voiced effect of a fine orchestra, quite a number of switchboards are required. Dr. Cahill's design contemplated five switchboards, with a large number of generators, for the New York plant, but the great expense of that pioneer work compelled a large reduction in the number of generators and the omission of three of the five switchboards. The distinctive tone and timbre of the music were there, but the full orchestral effect which the inventor desired was not. In this important particular, then, the plant fell below the ideal, not from any defect in the invention, but from necessary requirements of economy; notwithstanding all of these economies the original New York plant cost almost $200,000.

Another of the difficulties with the original New York plant was that on account of the interactions or reactions of the electrical circuits, the more keys of any one keyboard were depressed at the same instant (that is, the fuller the chord) the less loud each individual note became; and a point was easily reached where the loudness and strength of a chord were less than that of a single note. This defect is known at the laboratory and among the musicians as robbing—that is, one note robbed another of its strength. It was never serious so long as only one note like a single orchestral "voice" was played on each keyboard; it was scarcely noticeable with two notes on a keyboard. When the number of keyboards is small, or when one musician plays alone, it is extremely desirable to be able to take a full chord with either hand, as on the pianoforte or organ. In the new Telharmonium the circuits, switches and transformers have been reorganized in such a manner that full chords can be played on the same manual and switchboard without any appreciable diminution in the strength of the individual notes, through the reaction of the circuits. When one considers that at times 50 or 60 circuits, corresponding to different harmonics of the different notes in the different switchboards, are acting upon the line and reacting on each other simultaneously, the manner in which each tone and overtone maintains its independence is quite remarkable.

Before Dr. Cahill had delivered the plant to the New York Company, to whom it was leased, he determined, if possible, so to improve the whole apparatus as to reduce the very great cost which the switchboard work involves. In the New York plant, the loudness of the note was controlled by the touch of the hand, and effects very similar to those of the bow were produced, but with short notes and rapid movement it was difficult to co-ordinate the dynamic control with the control of the pitch without much skill and experience on the part of the player. In the new plant these difficulties have been greatly reduced and some have been entirely eliminated.

Persons who have heard the Telharmonium, or dynamophone, as Dr. Cahill prefers to call it, have usually been surprised at the round and powerful tones which, under the influence of its electrical currents, were produced from an ordinary telephone diaphragm. But here also there were limitations which imposed burdens upon the performer. An ordinary telephone diaphragm responds well to powerful electrical vibrations so long as only one note is used. It also responds well for many of the chord effects, but there are other chord effects, particularly close chords in the bass, which if taken *fortissimo*, produce an unmusical sound—almost a growl. Dr. Cahill found two remedies for this defect. One was to produce one bass note from one diaphragm and line and another bass note from another diaphragm and line. This method obviously required a multiplication of lines and receivers, thereby involving a great increase in expense. Another remedy was to open up the chords in the bass. This method, however, involved the rearranging of the music in many cases. These difficulties have been completely overcome by a new receiver described below, which was designed by Mr. Arthur T. Cahill, who is associated with his brother in the electrical work.

All who have worked with high-frequency alternators have

learned the great difficulty of producing any considerable output at frequencies of more than, say, 1000 cycles per second. This was another point in which the New York plant fell below the inventor's standard and in which the superiority of the new plant is very striking.

Good intonation was obtained at the plant in New York, but this perfection of intonation was produced at the cost of much mechanical complexity, an expensive generating set, expensive switchboards and a new and difficult keyboard, which the musician had to study for a considerable time before using. The resulting musical gain was worth what it cost, but efforts were directed to reduce the cost and eliminate, as far as possible, all the difficulties involved. This move seems to have been in the right direction, for the difficulties to the musicians, which resulted from the complicated keyboards of the New York plant, often led them to neglect the best powers of the instrument in the effort to accomplish something musically with little experience in playing and little time to practice.

So soon as the so-called New York plant had been leased to the New York Company, and even before it was installed in New York, Dr. Cahill began another elaborate series of experiments with musical alternators and switchboards. A switchboard of greatly increased musical powers was built in 1906 and 1907, but, like the preceding switchboards, at a great expense. It was appreciated that one important way to reduce the expense of the switchboard work (paradoxical as this may seem) was by improving the generating set. Many alternators, of more or less novel construction, were built and tested in 1906, 1907 and 1908. Experiments were made also on high-speed journals and gearing, and much new work belonging to the switchboards proper was carried on at the same time. In 1908, the necessary preliminaries having been settled, the work on the new plant was pushed and the result is now apparent.

The new plant is much larger than the original New York plant. That plant had eight sections or panels of generators. The new plant has 24 sections in operation, with provision on the main frame and in the gearing system for others to be added later. The new sections are smaller and contain a smaller number of generators, but the individual generators, or at least those of high frequency, are much more powerful. In fact, the generators of the very highest frequency have many times the output ratings of the corresponding alternators in the New York plant. Almost the only feature of the New York equipment retained, without change, in the new plant, is the type of alternators, which are inductor machines. Even here, however, there have been changes in the details of the winding and in the shaping of the pole pieces, etc., the result of a long series of experiments.

The generating set is much larger and occupies a much larger space than the generators of the New York machine; on the other hand, the switchboards have been greatly simplified and cheapened and occupy much less space.

Each panel of generators is mounted upon a steel shaft about 8.5 in. in diameter, which runs in a cast-iron shell. These shells are assembled upon a steel main frame. The main frame is approximately 65 ft. long, 13 ft. wide and is built of 20-in. steel beams, mounted upon masonry. Great strength is apparent in the framework and foundations. The result is that the 24 high-speed shafts, before mentioned, each carrying a different group of inductors, run quietly and without any perceptible vibration.

As one might naturally expect, when 24 shafts are to be connected instead of eight, the gearing is much more complicated and expensive than in the New York plant. All the gears are completely cased and run in oil or lubricating grease. No explanation of the details is possible except with the aid of elaborate drawings, which at this stage would be of little interest to the public.

The generating part of the plant is so crowded in with the switchboards and their thousands of wires, on the one side, and the heavy machine tools of the laboratory on the other, that it was impossible to obtain a good photograph showing the whole.

Fig. 1 illustrates a small part of the generating set, showing some four or five of the 24 panels of generators. Fig. 2 shows one of the keyboards (the only one that is yet complete) with the musicians at work. Fig. 3 illustrates a portion of a switchboard which is being connected into service.

The steel shafts, carrying the inductors, are mounted on ball-bearings of chrome-nickel steel, made in Germany. This feature alone would be interesting to the intelligent central-station man. Here is an immense machine, with perhaps the most complicated gearing ever built, and 140 alternators, all running at high speeds, on ball bearings. The saving of power in the bearings alone is estimated at more than 150 hp.

The switchboards, even in their improved form, are of so complicated a nature that little can be told about them in a few words and little shown by a photograph. Detailed schematic drawings would be necessary, by which alone the mutual relations of the great number of circuits involved can be

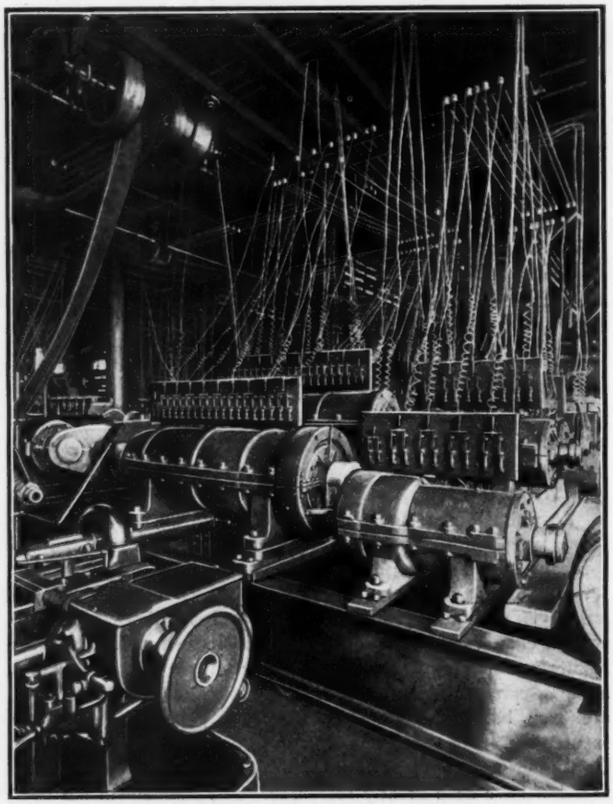


Fig. 1—Generators of Telharmonium.

understood. Central-station men who have struggled with the difficulty of making two alternators run in parallel, will appreciate what it means to work 140 alternators, in parallel, without hitch or trouble in any of the switchboards.

The new switchboards are characterized by much greater simplicity than those of the New York machine. Equally good effects are obtained in some cases with one-sixth the number of switches and circuits. In others, the electrical system has been reorganized in such a way that a great reduction in the number of transformers is effected. Moreover, the new switchboards are organized in such a manner as to make the musician's work easier—to improve and increase the powers of expression on the instrument. In particular, the features of touch-control, described in Dr. Cahill's first patent, have been, as before said, much improved, and in such a manner that the expense of the plant and the difficulties of the technique are reduced at the same time that the powers of expression are increased. Some new expression devices, also, have been added at the keyboards.

Mention was made above of the great increase in the power of the high-frequency alternators—the alternators for the

high-pitch notes. This increase is due partly to changes in scale, partly to higher speeds, partly to smaller air-gaps and improved windings.

In Dr. Cahill's Washington plant, built in the late '90's, the transformers used resembled the college induction coil or Ruhmkorf coil, more than the transformers used in electric lighting work. In the New York plant, the transformers were more nearly like the usual static transformers of electric lighting. In the new work the transformers are of the original

Fig. 2—Keyboard of Telharmonium.

type. The musical conditions are so far different from those of lighting circuits that the open-circuit transformers seem to be preferable to the closed-circuit transformers.

The new receiver, by which the electrical vibrations are converted into sound waves, is very different from that of the ordinary telephone. It has a much larger and heavier diaphragm—about 10 times as large and three times as thick. A more powerful magnet system is used and the disposition of the field and coils is strikingly different from that in common use. The correct formation of the air passages, as well as the length and depth of the horn itself, have received much attention from Mr. Arthur T. Cahill. Partly as a result of the increased size and weight of the diaphragm, partly from the

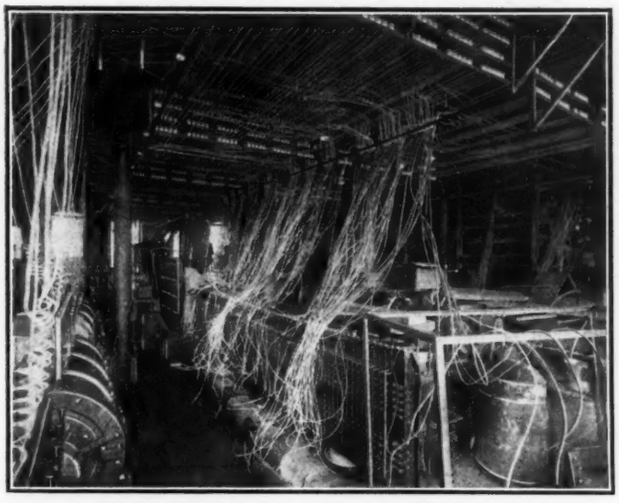


Fig. 3—Switchboard in Process of Erection.

greatly increased strength of the magnetic system, partly from the novel disposition of the same and the novel shape of the air passages, a most striking effect is produced. A single diaphragm responds powerfully to any sound, from the deepest bass to the highest treble of the machine; to a pure tone or a highly composite tone; to a single note or to a full chord. The volume and purity of the sound is very striking.

From the generating equipment described above may be obtained currents for superposition at any available number of switchboards by any desired number of performers at the manuals. In general, there would be a separate manual for each switchboard. The switching arrangements are such that at each manual the ground tone and over tones for each note can be superposed in any chosen proportion to produce any desired quality of tone; for example, to imitate the 'cello, the oboe or the clarinet at will. At each manual the performer makes the adjustments for the quality desired, just as is done with a pipe organ, but the range of adjustment is far greater with the Telharmonium. With a pipe organ, each stop sounds with its full strength or not at all; at a wind pressure less than that on which it is "voiced," it would sound out of tune. With the Telharmonium, on the contrary, any stop can be drawn more or less, so as to sound softly or loudly, accordingly as it is opened more or less, and it always sounds perfectly in tune, whether soft or loud.

The inventor, Dr. Thaddeus Cahill, has expressed the conviction that the most important musical effects of a large and fine orchestra can be produced electrically by the use of, say, 10 manuals, with one performer for each and a sufficient set of generators to furnish all of the necessary harmonics. The music, of course, of this electrical orchestra would not be exactly the same as that of the orchestra of bows, wood-winds and brass. It would certainly be better in some ways; it might not be so good in others. It is hard to find two pianos or two violins that are exactly alike. And the differences between the electrical violin tones and the tones of a Stradivarius will probably be greater than the difference of tone between a Stradivarius and a Guarnarius. The electrical music, while capable in a way of imitating all sorts of instruments, has yet its own strongly-marked individuality. It is capable of producing tones of all sorts of timbres, by combining the different harmonics or overtones and the ground tone in different ratios. It can produce different orchestral "voices" at the same time, by employing one switchboard and keyboard for one voice and another switchboard and keyboard for a different voice. It possesses remarkable powers of expression which it gives to the performer, equaling those of the violin in respect of soft-and-loud effects, with that control over the loudness of the note at every instant which only the bow possesses, while excelling the violin in chord capacity or double-stopping power and range of timbre-control. It has a remarkable goodness of intonation, which is equal, if not superior, to that produced by the finest quartet, and much superior to that produced by a full orchestra, with brass, wood-winds and strings. All of the above features make it clear that the goodness of the music of a telharmonic plant will depend only upon the number of generators and switchboards—the capital invested—and the skill of the players.

A third switchboard is being connected in, as Fig. 3 shows, and others will be added later. With only two switchboards in service it is yet possible to obtain a range of quality much superior to the most elaborate pipe organ or at least to obtain much more effective tones than the best organ furnishes, with a range of expression equal to that found in orchestral music.

In comparing the new Telharmonium with the piano, violin or organ, one should think of the millions of those instruments that have been built, of the thousands of years of evolution that lie behind them, of the vast armies of teachers and players in all countries of the world, of whom a few of the best only, like Paderewski, Hoffman, Ysaye, Kreisler and Elman, stand forth, with their great genius and their long training, to show what can be done with those instruments. One should remember that the latest is only the third Telharmonium that has been built and that the players who used it had only a few weeks' experience with its new technique—the best of them, the pianist, Mr. Paul Fishbaugh, of Washington, D. C., only four days. When these facts are borne in mind, an electrician, at least, can be excused for thinking that the day is near when the superiority of the electrical music to the music of string and pipe will be as obvious and incontestible as the superiority of a fine automobile to a farmer's wagon. But the electrician

will not be alone in this view. All the musicians who have seen the new Telharmonium are in love with it. And almost every person who hears it considers it as the music of a future that ought to begin at once.

The new plant has cost Dr. Cahill about $200,000 to date.

Apart from the striking improvement in the musical effects which have been made, the chief merit of the new plant lies in the great reduction effected in the cost of the switchboard work. The new generating set, with its gearing, is, as before said, even more expensive than the generating set of the New York machine, but it is also a much better, more powerful and more nearly complete generating set. The great importance of the reduction made in the cost of switchboards results from the fact that numerous switchboards are necessary in order to produce a full orchestral effect. With the improvements made these switchboards can be added at a cost that is not prohibitive.

The inventor claims that for $300,000 a powerful plant, with eight good switchboards, can be built at the present prices of labor and material, while three good switchboards and enough generators to make a respectable beginning in a city having 200,000 or 300,000 inhabitants can be furnished for $125,000. With such reductions in cost, combined with the great improvements in the musical effects before described, the electrical music ought to come into general use at an early date.

In all of the electrical music work Dr. Cahill has, from the beginning, had the valuable co-operation and assistance of Mr. Arthur T. Cahill, and the new receiver, which adds so much to the musical effect, is the latter's work. A third brother, Mr. George F. Cahill, has given his co-operation also.

The improvements made in the new plant may be briefly stated to consist in a great improvement in musical effects, combined with a great reduction in the cost of the plant. This reduction in cost arises chiefly from the greatly increased power of the high-frequency generators and various improvements in the generators and their gearing, a great simplification in the switchboard work, and the improved receivers by which a single receiver and a single pair of lines is made to do the work which formerly required several receivers and several pairs of lines. The improvements in musical effects arise chiefly from the greater strength of the highest notes and of the higher harmonics, the improvements in the expression devices, and the simplifying of the keyboard and switchboard work, making it much easier for a performer, familiar with the pianoforte or pipe organ, to play upon the new Telharmonium.

STREET ILLUMINATION.

Photometric Tests of Street Lighting in Budapest.

By Francis Jehl.

As the street lighting in Budapest, which was designed and erected by Mr. Etienne de Fodor, general manager of the Budapest General Electric Company, had given entire satisfaction in every respect for nearly a year, Mr. de Fodor decided to have a series of photometrical tests made, which would tend to augment the good results so far obtained. This decision was communicated to the municipal authorities, who were pleased with the idea, and promised to be represented at the tests by several members of their technical staff. In order to impart an impartial character to the tests, it was decided to call in an outside expert to act in conjuncion with a local committee. As expert, Mr. William Wissmann, of Berlin, was chosen; he is also a member of the German Standardization Commission, and who has had a large experience with arc lamps, street lighting and everything pertaining thereto. The names of the members of the local lighting committee are as follows: E. de Fodor, general manager Budapest General Electric Company. D. Jasz, technical councillor to the State; A. Söpkez, professor at the Budapest Polytechnic; A. Heuffel, chief of the Building Department; J. Rozsenyi, chief city chemist; E. Modrovich, assistant city chemist; B. Semsey, chief engineer of the city; J. Vukasinovits, chief engineer of the city; A. Stromszky, general manager of the Siemens-Schuckert Works; F. Jehl, engineer of the Budapest General Electric Company; C. Járolimek, engineer of the Siemens-Schuckert Company; J. Nitsche, R. Fuzy, G. Jaczo, L. Ban, as assistants. The photometer used was a Weber type; made by Schmidt & Haensch, of Berlin, while the standard was a small tungsten lamp that was carefully standardized in Berlin, and received its current during the tests from a small portable storage battery. The standard lamp was adjusted by varying the resistance of the circuit in accordance with the indications of an ammeter. It may be here mentioned that it has been found far more practicable and exact to regulate a standard lamp with an ammeter than with a voltmeter connected across its terminals, since the error caused by a faulty contact in a voltmeter circuit can produce misleading results.

The diffusion plate from which the light intensity was measured, consisted of a carefully ground surface of plaster of paris, which was treated with an oxide of magnesia.

It has been found that such a surface gives the least possible error, while white paper, ground glass or simple plaster of paris and other kinds of surfaces often used are liable to errors that may be as great as 50 per cent and more. In connection with the above subject, it may be mentioned that researches have been carried on in the laboratory of Siemens-Schuckert for over a year, and that the outcome of the work

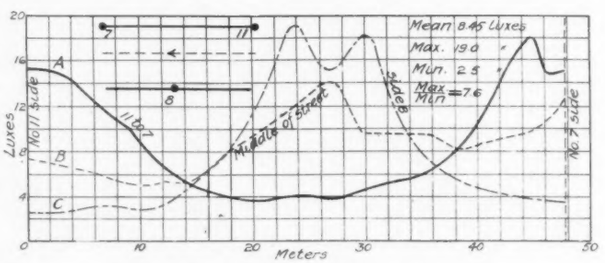


Fig. 1—Distribution Curves, Arc Lamps.

was that the plaster of paris-magnesia plate has been found to excel all other kinds. The height of the plate from the level of the ground was fixed at 1 m and from this height the intensities were measured. It is also said that the German Standardization Commission will propose the 1-m height as the standard to be taken in photometrical measurements. In laying out the lines upon which the measurements were to be carried out, the local committee decided to measure the various intensities between two arc lamps in a direct line on one side of the street, then a corresponding one on a parallel line in the middle of the street, and similarly on the other side of the street, where one arc lamp was situated. The lamps in the Rakoczi street are placed zigzag, first on one side of the street and then on the other. Sufficient data were obtained to give a very good idea of the distribution of the light. All precautions were taken to guard against vagabond rays; the tests were commenced at midnight and lasted generally until 5 o'clock in the morning, shops being thus closed, and the street gas lamps were turned off during the time of testing.

The results of the first night's work are shown in Fig. 1; above the curves is shown a sketch of the area tested and the position of the arc lamps. Curve A gives the various intensities from arc lamp No. 11 to arc lamp No. 7 in a direct line, while curve B gives the intensity in luxes for the middle of the street from side 11 toward 7, as shown in the dotted line above the curves. Curve C gives the light intensity along the side where arc lamp No. 8 is situated. The width of the street was about 29 m, while at arc lamp No. 11 a small square is situated, and thus from this side there was no reflection as buildings sometimes offer. From the curves it will be seen that the mean intensity is about 8.45 luxes, the maximum 19,

and the minimum 2.5. Dividing the maximum by the minimum; that is, $\frac{\text{Max.}}{\text{Min.}} = 7.6$; the coefficient of the light distribution, which in the above case shows that the light is well distributed and even. The ideal distribution would of course be when $\frac{\text{Max.}}{\text{Min.}} = 1$, which, however, can never be obtained in practice, and it may be mentioned that there are many cities that are considered well lighted whose coefficient of distribution varies from 20 upward.

The arc lamps used in Rakoczi Street are the direct-current Alba flaming type, and are connected three in series on a 110-volt circuit, taking 15 amp. The Alba electrodes are placed vertically in the lamp, while both positive and negative are cored. The height of the arc from the street level is 9.1 m, while the lamps are separated from one another at a distance of about 35 m, and from 48 m to 50 m.

Fig. 2 gives the measurements that were made with the same group of lamps as in Fig. 1, except that the lamps were lowered from 9.1 m to 8 m from the street level.

Here it will be seen that there is hardly any difference in the mean intensity, which is about 8.55 lux, while the maximum intensity went up to 28.8 lux. The minimum is a little lower, so that the distribution coefficient runs from 7.6 up to 12. The

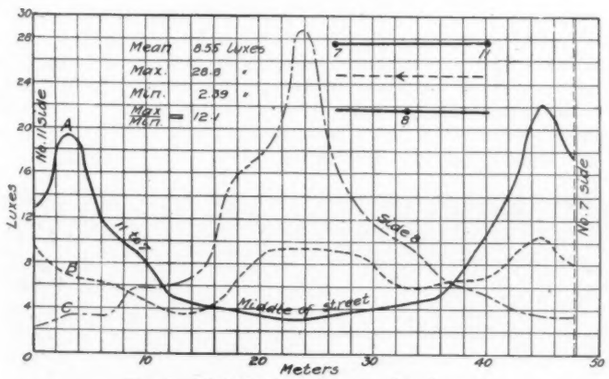


Fig. 2—Distribution Curves, Arc Lamps.

three curves shown in Fig. 2 give some interesting points, and they clearly indicate that it would be a very bad policy to keep the lamps at a height of 8 m from the street level, as the distribution would not be anywhere near as good as that attained at the standard height of 9.1 m. It is self-evident that in street lighting with arcs, the maximum intensities take care of themselves, and that what is sought for is to place the lamps at such distances from one another and have the arcs at such a height from the level of the street, that the minimum intensity will be as high as possible, thereby tending to bring the coefficient of distribution as near to unity as possible and within practical and commercial limits. Too much maximum and too little minimum mars the beauty of any kind of lighting, and to remedy such defects requires the judicious selection of the right kind of arc lamps and the proper disposition of the same.

Fig. 3 gives the results of a test that was made in another part of the Rakoczi street where the width was 33.5 m, and where both sides are lined with buildings which, however, offer no special reflection, as they are all of a dark color. Here it is seen on comparison with Fig. 1 that the mean intensity is 5.88 against 8.45 luxes, as given in the first test, while the coefficient of distribution is 8.8. Although these results are not as good as those given in Fig. 1, they produce nevertheless a very fair distribution, for in practice a well-lighted street can have any value for its distribution coefficient that varies from 12 downward. It may be mentioned that some time ago measurements were made in Berlin in some of the principal streets, and it was found that the coefficient of distribution varied there from 4.3 up to 63 in streets that were lighted according to modern methods with arc lamps, while some that were lighted with high-pressure gas varied from 20.5 to 72, and in other streets that were lighted with the ordinary Welsbach mantles under the usual gas pressure gave values of from 44 to 97. It may be mentioned that other parts of the Rakoczi street were tested and the results that were obtained corre-

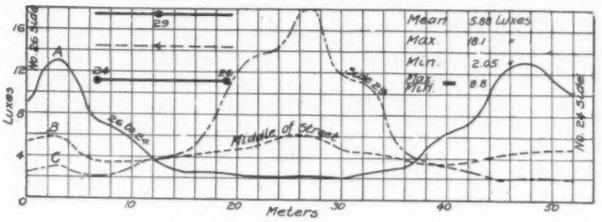


Fig. 3—Distribution Curves, Arc Lamps.

spond in general with those already given, so that the gist of all values found confirm the fact that the trial street lighting which Mr. Etienne de Fodor planned and erected fills the bill in all respects and that there will be a general extension of it very soon in all principal streets.

Fig. 5 gives a view of the Rakoczi street taken at about 11 o'clock in the night, and from which it will be seen that not only is the street well lighted, but the illumination is such that a building that projects into the street at a point about 500 m distant is plainly visible.

After the committee had finished the arc-lamp tests above described, it was decided to test some gas lamps with inverted mantles which the gas company had erected at the intersection of two avenues, and in opposition to the Alba arc lamps. Each gas lamp post is fitted with three arms, each arm having five inverted Welsbach burners, making a total of 15 burners per lamp post. The height of the burners from the level of the street is 5 m, and each burner consumes 115 liters of gas per hour, so that the 15 burners on each lamp post take 1725 liters of gas per hour. The photometric measurements were taken along two lines, which was considered as sufficient, as the lamp posts are situated evenly from one another.

Fig. 4 gives the results that were obtained with the gas lamps; here curve A shows the various intensities in luxes from lamp post G_1 to lamp post G_3, while curve B gives the intensities for the middle of the street from side 1 toward side 3. It is evident that the results for 2 toward 4 must be about the same as those from 1 to 3. Curve C gives the in-

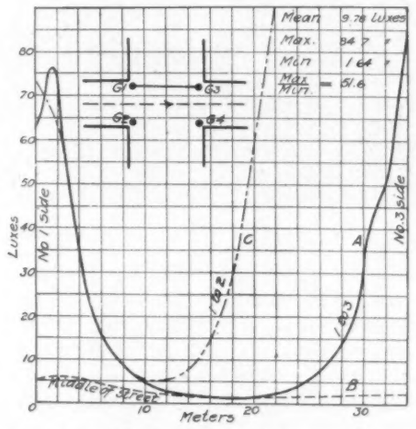


Fig. 4—Distribution Curves, Incandescent Gas Lamps.

tensities between the line G_1 and G_2. The curves show plainly that the intensity of the light near the lamp post is very high, and that it falls rapidly with the distance from it, while at the middle of the street it is very low, and thus produces a painful contrast—that is, it hurts the eye. Tabulating the results that

have been obtained in the above-described tests, the following table is obtained. It shows that the arc is much better adapted for street lighting than gas.

In the table it will be noted that the consumption per gas lamp is taken at 2025 liters per hour, whereas the 15 burners

RESULTS OF PHOTOMETRIC TESTS IN RAKOCZI STREET IN BUDAPEST.

Lamp posts tested	7, 8, 11	7, 8, 11	24, 26, 29	G1, G2, G3, G4
Type of lamp	Alba lamps, 3 in series, 15 amperes.		110 volts,	Inverted gas mantles
Height of arc or burner from street level in meters	9.1	8.0	9.1	5.0
Distance of one lamp post from another in meters	35 and 48	35 and 48	35 and 52	22 and 34
Width of street in meters	29	29	33.5	34 " 36
Street area per lamp post in square meters	888	888	90	740
Consumption per lighting unit	550 watts, including resistance			2025 liters per hour
Consumption per 100 square meters of street area	62 watts	62 watts	61.8 watts	274 liters per hour
Consumption per lux and 100 square meters	7.32 watts	7.24 watts	10.52 watts	28 liters per hour
Mean horizontal intensity in luxes	8.45	8.55	5.88	9.78
Max. horizontal intensity in luxes	19.0	28.8	18.1	84.7
Min. horizontal intensity in luxes	2.5	2.39	2.05	1.64
Coefficient of distribution, max.–min	7.6	12.1	8.8	51.6

themselves consume only about 1725 liters per hour. In connection with each of the burners there is a tiny gas jet that burns continuously day and night, and which is only used to light the burners in the evening. These small jets consume about 5 liters of gas per hour, so that in a year they take about 43,800 liters of gas per jet. The gas lamps are lighted on an average about 2000 hours per year, so that the gas consumed by one jet can be reckoned in reality at 21.9 liters per hour, while for the 15 jets that one lamp post contains 300 liters of gas can be added to the 1725 that the burners consume, making a total of 2025 liters. Taking the price of gas at actual cost, which is about 2 cents per cubic meter, and the price of electric energy at 3 cents per kw-hour, which Mr. Etienne de Fodor offered to the city, it will be found that the relative costs between gas and electric light per lux and 100 sq. m to be for electric lighting $\frac{8 \times 3}{1000} = 0.024$ cent and for gas lighting $\frac{28 \times 2}{1000} = 0.056$ cent. The costs for carbons, trimming, switching on and off the arc lamps, repairs, interest and amortization, etc., amount to 0.022 cent per 8 watts, so that the total cost for electric lighting amounts to $0.024 + 0.022 = 0.046$ cent. Calculating on the same basis the costs for the renewal of the gas mantles, and all the other items mentioned above in connection with electric lighting, it will be found that when 0.01 cent is assumed for every 28 liters of gas it is a very liberal figure. This brings the total amount for gas lighting up to $0.056 + 0.01 = 0.066$ cent. These figures show that under the conditions obtaining, electric lighting is much cheaper than gas lighting, and gives a difference of about 44 per cent.

In conclusion it may be mentioned that the photometer readings were taken during the tests by Mr. Wissmann and Professor Söpkez, and after they were finished all instruments were taken to the laboratory of Professor Söpkez at the Budapest Polytechnic and calibrated, and it was found that none had altered their constants.

Fig. 5—View of Rakoczi Street, Budapest, at Night.

IRRIGATION PUMPING.

Rates Charged for Electric Service in Colorado.

By E. C. Reybold, Jr.

IRRIGATION pumping is making such wonderful strides that every power plant will do well to make careful investigations of its territory in order to secure all possible benefits from this excellent means of filling in the low load curve of the summer months. Every company selling energy can well afford to make strong inducements to assist in building up this load, and a careful study of the peculiarities of the business brings out some interesting points relative to the rates that should apply.

Irrigation pumping rarely begins before April 1 and seldom continues later than Sept. 30, and, therefore, this load never conflicts with the heavy load of fall, winter and spring. Motors operating pumps are usually run quite continuously, and the number of kw-hours used by a small pumping plant is something remarkable. It is almost impossible to conceive of securing sufficient pump motors on the lines of a large power plant to build up a peak load during the irrigation season equal to that of the winter, and if any plant were so fortunate as to have such a load it would still be able to take on additional pump motors by restricting the hours of operation to those off the lighting peak. Contracts for energy for irrigation work can be made just as readily with such restrictions as without, and it is a good plan to have them in contracts, although it is not probable that it will be necessary to enforce them.

It is almost always necessary to extend lines to reach new

pumping plants, these lines sometimes being several miles in length. It is often advisable, from the power-plant viewpoint, to require the prospective customer to pay for the line to reach his pumping plant, but not only is it a very difficult matter to show a landowner why he should pay for such a line, but it is a question whether such a plan is a good one. It is usually better for the power plant to own all lines in order that it may take on any additional load that it desires without question, and some arrangement should, therefore, be made whereby the power plant is guaranteed sufficient revenue to pay for depreciation and maintenance of the line and interest and dividend upon the investment. The Northern Colorado Power Company requires an annual minimum revenue of from one-third to one-half of the total cost of the line extension and concedes that all consumers upon the extension may combine to make up this total. There are certain advantages in these plans in that when a consumer signs up for a greater minimum than he thinks he will use he immediately becomes an enthusiastic advocate of electric energy, and uses good influence toward getting additional customers on the line.

For motor installations of moderate size it is customary to make a monthly readiness-to-serve charge of from 50 cents to $1 per horse-power plus various rates per kw-hour. These horse-power charges are doubtless the result of similar charges usually imposed in cities, but it is a question if they should be applied to irrigation work. Charges of this nature are based fundamentally upon the cost of installing and maintaining the power-plant equipment required to operate the motors, and when motors are run during the winter peak such charges are entirely legitimate. If the power plant costs $120 per horse-power of rating, it is evident that each horse-power in motors operated during the peak requires the use of $120 worth of equipment, upon which is should pay interest and depreciation, and a charge of $1 per month gives only 10 per cent upon this investment.

When it is remembered that motors used for irrigation work do not operate during the winter peak, it will appear that a charge of this nature is hardly necessary, as the equipment that will carry the winter load will usually more than carry the summer pumping load. But, if the power plant secures so much summer load that additional power can be supplied only after the installation of more equipment, then a readiness-to-serve charge becomes legitimate. After securing a number of customers who pay no readiness-to-serve charge it would be difficult, indeed, to prove to prospective customers the necessity of such a charge and the final decision either in favor of or against a readiness-to-serve charge should be made before any business is solicited. Farmers object strenuously to paying for anything that they do not get, and the ideal method of charging from their viewpoint is by the meter, only without any readiness-to-serve or minimum. A horse-power charge without any meter charge is of advantage to the power plant as it guarantees a fixed revenue regardless of the condition of the weather, but it is distasteful to the farmer, who always likes to save when he can by stopping his pumping plant when weather conditions are such that he does not need to operate it. It is of disadvantage to the power plant in that it is human nature for one who is paying for the energy anyway to operate his motor continuously whether he really needs water or not. If the power plant is operated by fuel an extravagant use of energy is not to be encouraged, but if by water-power it makes but little difference, and such a method of charging is not bad for a water-power plant that has an over abundance of water supply during the irrigating season.

A straight charge per kw-hour without any horse-power charge is frequently satisfactory when there is either no pole line to be extended or its cost is paid by the customer. In such a case the power plant has absolutely no equipment tied up if it is the winter peak that determines the power of the equipment in the plant and not the load while the irrigation pumps are running. Such a method of charging is by far the most satisfactory to the farmer, and it appears that it may be under certain circumstances entirely so to the power company. Of course, a monthly income from each motor on the line is desirable as it is possible that with certain weather conditions some pump motors may not be operated at all during some months, but it must be remembered that the farmer has money tied up in his pumping plant and is paying interest and depreciation on it, and it is a question whether he should be compelled to pay anything to the power plant when he does not operate his motor. At any rate, it will be found that more objections are raised by farmers to paying for something that they do not get than anything else, and readiness-to-serve charges are stumbling blocks which cause many landowners to hesitate. It is impossible to prescribe any general rules for determining rates for irrigation pumping, as it is seldom that similar conditions will be found in any two places. The load is so desirable that a careful study should be made of each proposed plant in order that the rate offered may not only be profitable to the power company, but acceptable to the irrigator who is, indeed, a very difficult man to handle.

Some rates for irrigation pumping that have either been offered or are in actual use are given below:

1. For motors up to about 50 hp, 2200-volt energy is delivered, the customer furnishing transformers if necessary. An annual minimum equal to one-third or one-half the cost of the line extension is required on a five-year contract. There is a monthly charge of $1 per motor horse-power during the irrigation season only, plus all current used at 3 cents per kw-hour.

2. For motors up to about 50 hp, 6600-volt energy is supplied without any guarantee or contract, the customer furnishing transformers. There is a monthly charge of 50 cents per motor horse-power during the irrigation season plus all current used at 3.5 cents per kw-hour. This rate is very favorable to the farmer, and many pumps are in operation on the lines of the company offering it.

3. For a pumping plant of about 1200 hp, 44,000-volt energy was offered at 1.25 cent per kw-hour, the customer to supply transformers, lightning arresters, etc. The power company was to run about four miles of 44,000-volt line without any guarantee.

4. For a pumping plant to use a total of about 1100 hp, of which 150 hp was to be installed the first year, 44,000-volt energy supplied from water-power was offered at $5.50 per horse-power per month for the months during which it was to be used, this price decreasing to $4.50 per horse-power per month when the full installation was in operation. The customer was to install his own transformers, lightning arresters, etc., and to pay for the line extension.

5. For a pumping plant about like the fourth, 44,000-volt energy was offered by a water-power plant at 7/8 cent per kw-hour without any horse-power charge, the customer to install his own substation and build the 44,000-volt line extension. The customer was also to pay for the transformer losses, the meter to be on the low-tension side of the transformers.

Theoretically, it takes 1.068 kw-hour to pump an acre-foot of water 1 ft. high. If the motor efficiency is 88 per cent and the pump efficiency 68 per cent, the combined efficiency will be 60 per cent and 1.78 kw-hour will be required to pump an acre-foot of water a foot high. This is a little better efficiency than is usually obtained, and it is better to estimate a power consumption of 2 kw-hours per acre-foot pumped 1 ft. high. An acre-foot of water, or sufficient to cover an acre of land with water to a depth of 1 ft., is usually deemed ample for each acre of land in a season. In northern Colorado for potatoes they frequently use as little as two-thirds of an acre-foot of water per acre, but for fruit in western Colorado they use as much as 2 acre-feet, and even 3 acre-feet, although such a quantity of water is deemed by the best farmers to be injurious to the land.

Regardless of the size of the pump or motor, and of the length of time required to do the pumping, the same number of kw-hours will be required to pump an acre-foot of water to a certain height, provided only the efficiencies of the different plants are the same, and the annexed table has been compiled upon this basis. By consulting it, it will be found possible to determine quite accurately what it will cost to irrigate an acre

of land per season at various rates for electric energy. The table is based upon a kw-hour charge only, and any readiness-to-serve charges must be added. Horizontal centrifugal pumps, direct-connected to motors, with a total efficiency of 60 per cent, are assumed.

If the pump capacity is under 900 gal. per minute, the following additions should be made: 10 per cent for 700 gal. per minute; 20 per cent for 500 gal. per minute; 30 per cent for 300 gal. per minute, and 40 per cent under 300 gal. per minute. The values corresponding to heads below 10 ft. may be a little low unless pumps are of large capacity. The costs for higher heads are in proportion. For instance, costs for 95 ft. equal costs for 45 plus 50 ft. For belted units add 5 per cent. A good centrifugal pump with capacity of 900 gal. per minute or more will give 68 per cent efficiency. If a vertical pump is used add from 5 per cent to 100 per cent in accordance with the type of pump, style of setting and method of carrying or balancing the downward thrust of the shaft and runner.

COSTS OF PUMPING IN DOLLARS PER ACRE PER SEASON.

Cost Per Kw-Hour Cents	Total Head in Feet, Including Friction									
	5	10	15	20	25	30	35	40	45	50
0.25	0.02	0.04	0.06	0.08	0.11	0.13	0.15	0.17	0.19	0.21
0.50	0.04	0.08	0.13	0.17	0.21	0.25	0.29	0.34	0.38	0.42
0.75	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.50	0.57	0.63
1.00	0.08	0.17	0.25	0.34	0.42	0.50	0.59	0.67	0.76	0.84
1.25	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.84	0.95	1.05
1.50	0.13	0.25	0.38	0.50	0.63	0.76	0.88	1.01	1.13	1.26
1.75	0.15	0.29	0.44	0.59	0.74	0.88	1.03	1.18	1.32	1.47
2.00	0.17	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68
2.25	0.19	0.38	0.57	0.76	0.95	1.13	1.32	1.51	1.70	1.89
2.50	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.10
2.75	0.23	0.46	0.69	0.92	1.16	1.39	1.62	1.85	2.08	2.31
3.00	0.25	0.50	0.76	1.01	1.26	1.51	1.76	2.02	2.27	2.52
3.25	0.27	0.55	0.82	1.09	1.37	1.64	1.91	2.18	2.46	2.73
3.50	0.29	0.59	0.88	1.18	1.47	1.76	2.06	2.35	2.65	2.94
3.75	0.32	0.63	0.95	1.26	1.58	1.89	2.21	2.52	2 84	3.15
4.00	0.34	0.67	1.01	1.34	1.68	2.02	2.35	2.69	3.02	3.36
4.25	0.36	0.71	1.07	1.43	1.79	2.14	2.50	2.86	3.21	3.57
4.50	0.38	0.76	1.13	1.51	1.89	2.27	2.65	3.02	3.40	3.78
4.75	0.40	0.80	1.20	1.60	2.00	2.39	2.79	3.19	3.59	3.99
5.00	0.42	0.84	1.26	1.68	2.10	2.52	2.94	3.36	3.78	4.20

TRANSMISSION LINE CALCULATIONS.

A Short Method for Determining the Regulation.

By John F. H. Douglas.

IN a transmission line, inductance and capacity are not concentrated at any one point, but distributed throughout the line. To explain the phenomena of such a line by concentrated inductance and capacity is as futile as to try to explain the motion of an elastic string (such as a piano wire) by the mechanism of concentrated mass and elasticity. The motion of the string is wave-motion, as is also the movement of electricity in a transmission line. The various formulas and assumptions may be regarded, therefore, simply as approximations more or less exact. The engineer wants a method which shall be exact, but at the same time easy to apply. The exact equation of the transmission line has been known for a long time, but it has been in a form not easy to apply. This article derives from the exact formula a simple equation which is equally as exact.

The exact equation may be found in McMahon's Hyperbolic Functions; it is,

$$\dot{E}_g = \dot{E}_1 \cosh \sqrt{\dot{Y}\dot{Z}} + \frac{\dot{I}_1 Z \sinh \sqrt{\dot{Y}\dot{Z}}}{\sqrt{\dot{Y}\dot{Z}}}$$
$$\dot{I}_g = \dot{I}_1 \cosh \sqrt{\dot{Y}\dot{Z}} + \frac{\dot{E}_1 Y \sinh \sqrt{\dot{Y}\dot{Z}}}{\sqrt{\dot{Y}\dot{Z}}} \qquad (1)$$

In these equations E_g and I_g represent the voltage and the current at the generator. E_1 and I_1 represent the voltage and the current at the load end. $Z = r + j\,2\pi fL$ or the line impedance, $Y = g + j\,2\pi fC$, where g is the leakage conductance and C is the capacity of the whole line. Cosh and sinh are functions of the complex variable $\sqrt{YZ}$ and are defined by the equations,

$$\cosh \sqrt{YZ} = \frac{\varepsilon^{+\sqrt{YZ}} + \varepsilon^{-\sqrt{YZ}}}{2}$$

$$\sinh \sqrt{YZ} = \frac{\varepsilon^{+\sqrt{YZ}} - \varepsilon^{-\sqrt{YZ}}}{2}$$

As the equation stands it is needful, in order to solve a numerical problem, first to evaluate $\sqrt{YZ}$, and then to determine the hyperbolic functions, either from double interpolation from a table of such functions of a complex variable or else to expand these functions into a trigonometric form. The first, as well as the second, step is very long and tedious, and hence a simpler form is needful if one wishes to perform many calculations.

McLaurin's theorem in calculus furnishes us with a method of expanding a function in ascending powers of the independent variable, and it will give the formula desired. McLaurin's theorem states that

$$f(x) = f(o) + f'(o)\,.\,x + f''(o)\,\frac{x^2}{\lfloor 2} + \ldots .$$

Now,

$$\frac{d\cosh x}{dx} = \frac{d}{dx}\left(\frac{\epsilon^x + \epsilon^{-x}}{2}\right) = \frac{\epsilon^{+x} - \epsilon^{-x}}{2} = \sinh x$$

$$\frac{d\sinh x}{dx} = \frac{d}{dx}\left(\frac{\epsilon^x - \epsilon^{-x}}{2}\right) = \frac{\epsilon^{+x} + \epsilon^{-x}}{2} = \cosh x$$

Also, $\cosh(o) = 1$ and $\sinh(o) = o$;

whence,

$$\cosh \sqrt{YZ} = 1 + \frac{YZ}{\lfloor 2} + \frac{Y^2Z^2}{\lfloor 4} + \ldots)$$

Also,

$$\sinh \sqrt{YZ} = \sqrt{YZ}\ \left(1 + \frac{YZ}{\lfloor 3} + \frac{Y^2Z^2}{\lfloor 5} + \ldots\right)$$

From the above we get by substitution in (1)

$$\dot{E}_g = \dot{E}_1\left[1 + \frac{YZ}{\lfloor 2} + \frac{Y^2Z^2}{\lfloor 4} + \ldots .\right] + \dot{I}_1 Z\left[1 + \frac{YZ}{\lfloor 3} + \frac{Y^2Z^2}{\lfloor 5} + \ldots .\right] \qquad (2)$$

$$\dot{I}_g = \dot{I}_1\left[1 + \frac{YZ}{\lfloor 2} + \ldots .\right] + \dot{E}_1 Y\left[1 + \frac{YZ}{\lfloor 3} + \ldots .\right]$$

In this equation Y and Z may be obtained from the regular handbook directly, but for convenience it is well to tabulate the product YZ for different spacings and frequencies.

$$YZ = \left(\frac{l}{1000}\right)^2 (-a + jb)$$

In this equation l is in miles, Y and Z in ohms, a varies as the square of the frequency f, and b varies as the first power of the frequency f.

$$a = f^2\ 0.001184\left(1.0105 - 0.000058\,\frac{D}{d}\right)$$
$$= f^2\ 0.001184 \quad \text{To a high degree of accuracy.}$$

$$b = f\ 1.2882\,\frac{R}{\text{Log}_{10}\,\frac{2D}{d}}$$

R is the resistance of the wire per mile in ohms,
D is the spacing between conductors in inches,
d is the diameter of the conductor in inches.

A natural question arises here: how the formula here presented compares with those used under the assumptions of capacity concentrated in the center of the line and two-thirds of the capacity concentrated in the center of the line. In Dr. Steinmetz's "Alternating Current Phenomena," pages 228 and 229, the equations for the above are derived, and in a somewhat simplified form are given below.

Capacity, all in the middle:

$$\dot{E}_g = \dot{E}_1\left(1 + \frac{YZ}{2}\right) + \dot{I}_1 Z\left(1 + \frac{YZ}{4}\right)$$

$$\dot{I}_g = \dot{I}_1\left(1 + \frac{YZ}{2}\right) + \dot{E}_1 Y$$

Capacity, two-thirds in the middle and one-sixth at each end:

$$\dot{E}_g = \dot{E}_l\left(1 + \frac{YZ}{2} + \frac{Y^2Z^2}{36}\right) + \dot{I}_l Z\left(1 + \frac{YZ}{6}\right)$$

$$\dot{I}_g = \dot{I}_l\left(1 + \frac{YZ}{2} + \frac{Y^2Z^2}{36}\right) + \dot{E}_l Y\left(1 + \frac{5YZ}{36} + \frac{Y^2Z^2}{216}\right)$$

Comparing the first equations with the ones derived in this paper it will be seen that even in the first approximation the formula here developed is more accurate. Comparing the second equations with those derived in this paper, it will be seen that in the second approximation the formula given above is again more accurate and this time also slightly more simple.

One of the problems of the engineer is to find the regulation of transmission lines. A simple formula can be given for this, too. From equation (1) at no-load it is seen that

$$\dot{E}_l' = \frac{\dot{E}_g}{\cosh\sqrt{YZ}}$$

whence by substitution in equation (1),

$$\dot{E}_l' = \dot{E}_l + \dot{I}_l Z\frac{\sinh\sqrt{YZ}}{\cosh\sqrt{YZ}\,\sqrt{YZ}} = \dot{E}_l + \dot{I}_l Z\left(\frac{\tanh\sqrt{YZ}}{\sqrt{YZ}}\right)$$

Expanding $\tanh\sqrt{YZ}$ by McLaurin's theorem,

$$\dot{E}_l' = \dot{E}_l + \dot{I}_l Z\left(1 - \frac{YZ}{3} + \frac{2Y^2Z^2}{15} - \frac{17Y^3Z^3}{315} + \ldots\right) \quad (3)$$

As an example in the use of the above formula a discussion of the question whether or not capacity improves the regulation of a transmission line will serve the purpose. As is well known, capacity causes a rise in voltage along the line from the generator to the load, but this effect is present both at no load and at full load. It is, therefore, not apparent what the net effect is. Refer now to the above equation. It is seen that the effect of capacity is to introduce a series of corrective terms, of which the most important is $YZ/3$. YZ is of the form $-a + jb$, where a and b are both positive. Hence because of the capacity the impedance is no longer Z, but $Z(1 + a - jb)$. The effect of a is to increase the impedance drop and the effect of b is to bring it more nearly into phase with the load voltage. The effect is, therefore, to make the regulation worse.

For instance, assume the following numerical example: Let it be required to work out the regulation of a 300-mile line having the following constants:

Power = 15,000 kw,
E.m.f. = 100,000 volts,
Current = 86.65 amp,
Frequency = 25 cycles per second.
Number of phases = three,
Conductor area = 250,000 circ. mils.
Spacing = 132 in.

From tables in handbooks:

$$Z = 65.60 + j\,93.45$$

$$YZ = \left(\frac{0.300}{1000}\right)^2(-0.738 + j\,0.503)$$

$$= -0.0664 + j\,0.0452$$

and $$Y^2Z^2 = 0.0024 - j\,0.0030,$$

but

$$\frac{\dot{E}_l'}{\sqrt{3}} = \frac{\dot{F}_l}{\sqrt{3}} + \dot{I}_l[Z]\left[1 - \frac{YZ}{3} + \frac{1}{15}Y^2Z^2 + \ldots\right]$$

whence

$$\frac{\dot{E}_l'}{\sqrt{3}} = \frac{100{,}000}{\sqrt{3}} + 86.65\,[65.60 + j\,93.45]\,[1 + 0.0221 - j\,0.0151 + 0.0003 - j\,0.0004]$$

$$\dot{E}_l' = 100{,}000 + \sqrt{3}\,(86.65)\;(65.60 + j\,93.45)\;(1.0224 - j\,0.0155)$$

$$= 100{,}000 + 150\,(68.52 + j\,94.53)$$

$$= 100{,}000 + 10{,}280 + j\,14{,}180$$

$$= 111{,}190.$$

$$\text{Regulation} = \frac{E_l' - E_l}{E_l} = \frac{111{,}190 - 100{,}000}{100{,}000} = 11.19 \text{ per cent.}$$

The final form of the equations is that of (2) and (3). In calculation of regulation, equation (3) will be found most convenient, while for calculating the characteristics equation (2) will be found most useful. In general, it should be sufficient to use only the first power terms of the expansion, but if needed the second power terms of the expansion may be easily evaluated. The simplicity and accuracy of the above formulas for the transmission line should commend them to those who may have to perform transmission line calculations.

Central Station

Management, Policies and Commercial Methods

CENTRAL-STATION MAINTENANCE.

The accompanying table shows the average cost of maintenance, per kilowatt of connected load, in certain towns under 3000 in population and in cities and towns of from 3000 to 6000 population. The data are the average of 33 cities in the first group and 21 cities in the second group. While in a few isolated cases in the first group the unit costs considerably exceed the average, the majority correspond very closely.

AVERAGE COST OF MAINTENANCE PER YEAR PER KILOWATT OF CONNECTED LOAD.

POPULATION	Connected Load, Kw	Total Cost	Unit Cost
Under 3,000	202	$564.00	$2.60
3,000 to 6,000	443	1,035.00	2.46

69 CENTS PER CAPITA FOR SPECIAL STREET LIGHTING.

The special street lighting installed on the principal streets of Albert Lea, Minnesota (about 6000 population), was described in the issue of December 9, 1909, page 1421. At that time it was considered a matter worthy of special comment that a town of 6000 inhabitants should install 50 ornamental street lighting posts with 160 watts in tungsten lamps on each post. The innovation attracted much attention in that part of Minnesota, but the citizens, having made a good start on special street lighting, recently followed it up by ordering 42 more posts in addition to the 50 previously ordered, thus making a total of 92 posts. The Albert Lea Light & Power Company receives $45.10 per annum per post, and furnishes the post complete on a five-year contract. When the total 90 posts are installed, the company will receive a revenue of $4,149 from this special lighting, which on a basis of 6000 population for the town is 69 cents per inhabitant per year.

EXTENSION OF THE HEATING AND COOKING DEVICE BUSINESS.

Mr. J. D. A. Cross in a paper prepared for the convention of the Minnesota Electrical Association, March 31, stated that over 300,000 flatirons have been sold, most of these being placed on trial. The electric iron is being universally adopted where residences are wired for electricity. In fact, many have wired just to use the electric iron.

In Mr. Cross' opinion, the toaster will develop into a more

standard and profitable device than the flatiron after consumers have been educated to its simplicity and practicability. The device is used in the presence of the head of the house at least seven times a week, whereas the iron is often paid for by the head of the house and lost sight of as soon as it gets into the servant's hands. The bread toaster by this method cannot be equalled by any other yet advanced, nor has the electric toaster any competition for preparing toast on the dining-room table. It will not be necessary to place the toaster on 30 days' trial, as one week should be sufficient to convince any person of its merits. Mr. Cross figured 600 kw-hours per month as the consumption of a toaster.

MAINTENANCE.

There are many ways in which to place these heating devices with customers, but the important thing is to see that the customers use the devices after they get them. In this connection, unless the central station sees that these devices are kept in order, a number of them will be put on the shelf. The central station should sell the device at a price that it can afford to make minor repairs without cost to the consumer. It should also keep in touch with the situation, so that it knows that the consumer is satisfied.

The companies which have been most successful in building up the day load with heating and cooking devices are those who guarantee the devices they sell. In order to do this, Mr. Cross thinks that central stations should sell these devices at about 25 per cent above cost. This will allow something for advertising and will also put dealers in a position to handle the devices. One company recently adopted a plan with a local hardware firm. The hardware firm handles all of the irons and sells them at $5 each. With each iron that is sold for cash the customer receives an order on the electric light company for $1 worth of current.

When a consumer comes with the question, "How much will it cost me to do my cooking and baking by electricity?" do not attempt to answer the question, but instead loan him a toaster, a coffee percolator or some other useful device and ask him to take it home and try it. He will find it not expensive, considering the convenience. These smaller devices will serve as an entering wedge, and after the customer has used them and knows from actual experience that they are convenient and simple, there will be little trouble in selling him a more complete equipment.

DEVICES ON TRIAL.

From the information Mr. Cross has collected from many central stations he finds that about 85 per cent of the irons and about 60 per cent of the toasters put out on trial are retained and used. There is no reason why at least 50 per cent of the other devices, such as disk stoves, frying pans, etc., would not be retained by customers if the trial proposition were followed out.

CENTRAL STATION PUBLICITY BY THE USE OF MOVING PICTURES.

At the recent Chicago Electrical Show considerable attention was attracted by a display of moving pictures, illustrating the uses of electricity in the home, given as one feature of popular lectures delivered afternoons and evenings. This was an unusual method of advertising central-station service, and the spectators were greatly interested, many of them returning a second time. A running commentary was delivered by the lecturer, and his remarks, often humorous, made the entertainment more enjoyable.

Accompanying this article are given sections of three of the films which were used. These will serve to illustrate the manner in which the idea was carried out. Each set of views illustrates one room in the house. The first is a scene in the electric kitchen. The electric range is shown at the right, and the cook is engaged in broiling a steak, cooking cereals, making coffee, waffles, etc. In the rear of the room is a kitchen cabinet, on which are an electric toaster, coffee percolator, corn-popper, egg-beater, "automatic kitchen" and other electrical devices. The cook is shown busily at work preparing the dishes, and the serving maid frequently enters and leaves the kitchen in pursuance of her duties. In the series of 12 views shown it will be noticed that she is entering the room. The action is carried out with vivacity.

Turning to the electric laundry, the pictures show an electric washing machine and wringer, near which is a mangle.

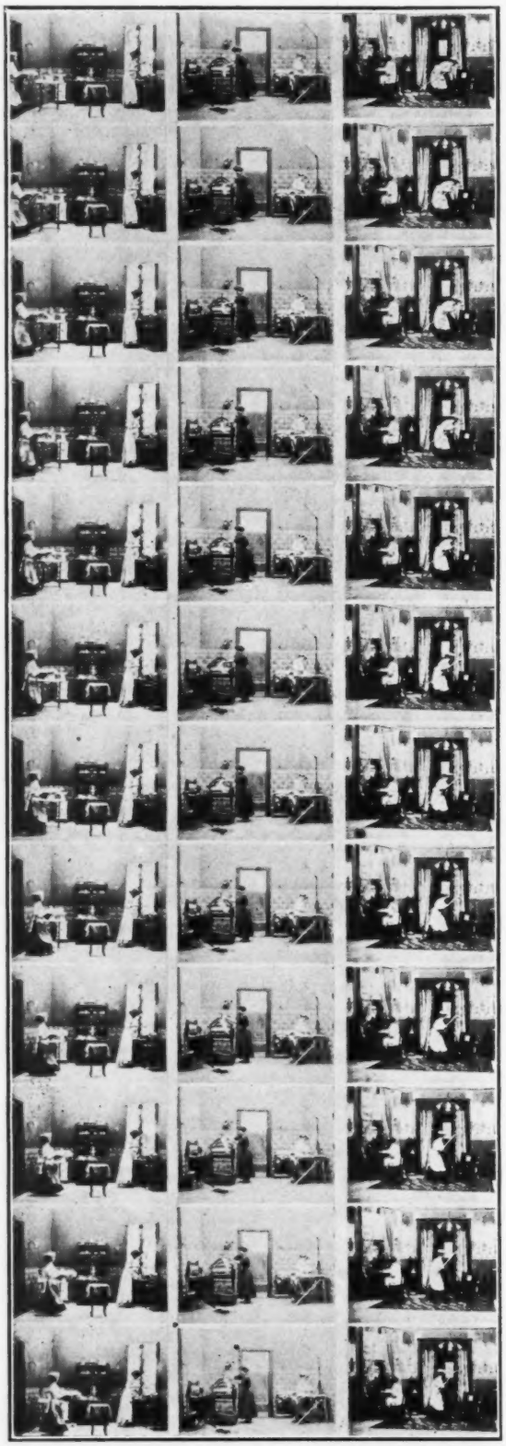


Fig. 1—Scene in Electric Kitchen, Cook Broiling Steak on Electric Grill; Maid Entering From Dining Room. Fig. 2—Scene in Electric Laundry: One Girl at Electrically-Operated Mangle, the Other Using Electric Flatiron. Fig. 3—Scene in Sitting Room: Mistress at Electric Sewing Machine, Servant Using Electric Vacuum Cleaner on Curtains.

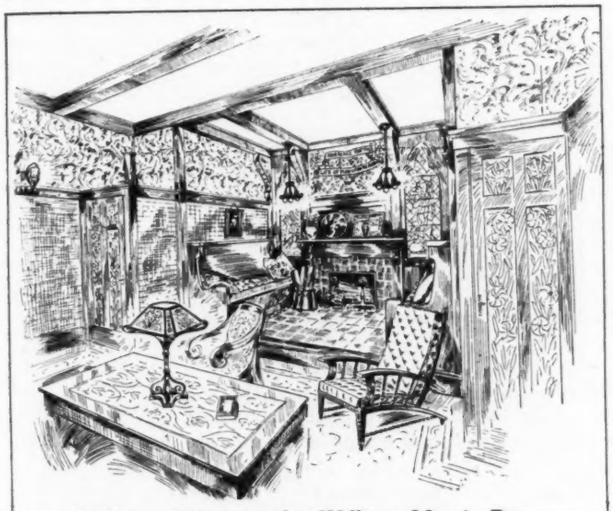
At the right-hand side of the room is an ironing board equipped for use with electric flatirons. This room also contains an electric radiator and an electric fan. The girls go through the various operations of washing and ironing clothes, with some amusing by-play thrown in.

The third series illustrates a scene in the sitting-room. At the left the mistress of the house is shown seated at her electrically driven sewing machine, while a maid, at the right, is engaged with an electrically operated vacuum cleaner cleaning draperies. Both operations are shown at the same time. This room contains a luminous radiator.

All the devices shown are actual electrical appliances. The characters remove the incandescent lamps from sockets and attach the connecting cord of the various electrically operated conveniences, except in the case of the electric range, everything being done exactly as in real life. The Commonwealth Edison Company expended considerable effort in getting these films made satisfactorily, as it was necessary to have performers before the camera who were both demonstrators of apparatus and actresses of some ability. After considerable drilling, however, a satisfactory series of films was secured. The result brought the varied use of electricity in the home to the attention of many thousands of persons more effectively perhaps than could have been done in any other way.

DIGNIFIED EDUCATIONAL ADVERTISING.

Attention may be directed again to the excellent daily newspaper advertising of the Commonwealth Edison Company, of Chicago. A fac-simile is given herewith of a three-column "ad" which appeared in the daily newspapers of Chicago a few days ago. The idea is to demonstrate the necessity for adequate lighting effects in artistic interiors, and it is worked up by using a drawing illustrating an actual interior, after the style of William Morris, in a local furniture store. This is accompanied by an article on lighting effects written by an expert in interior decorating, in which it is pointed out that without a liberal installation of electric light the effect in this beautiful room would be gloomy instead of being simply quiet. The advertisement was inserted entirely at the expense of the Commonwealth Edison Company, and although it happens that the Tobey Furniture Company is a customer of the central station, that fact was not taken into consideration in printing the advertisement. It is to be noted that the dissertation is thoughtful and convincing and that the style of advertising is in no way flamboyant. It should have weight with people who reflect. It may be added that the picture represents a living-room and is planned to typify a place of refuge from the turmoil of existence. Over the fireplace is a scroll reading "Reverence for the life of man upon the earth"—possibly a quotation from the writings of William Morris.



Lighting Effect in the William Morris Room
In the Tobey Furniture Co.'s Store

By N. L. Sevenson, of the Interior Decorating Department

This beautiful room embodies the ideas of William Morris on the "Living Room" as the center or "heart" of the home. These ideas are set forth in his "Decorative Arts."

The wall hangings, carpets, draperies, glazed tile and some of the furniture are of William Morris's own designs. The decorative panels, art glass windows, lamp and lighting fixtures and general arrangement of the room, were planned and executed in the studios of The Tobey Furniture Co.

Every one, no matter how unfamiliar with the arts of interior decoration, is struck at once with the quiet, repose, harmony and dignity expressed by the furnishings and arrangement in this room.

The room is essentially expressive of the idea of a "home"—a place of refuge from the turmoil of existence—and at the same time gives expression to the dignity of man's life on earth, as the scroll above the fireplace reminds one.

How is this idea attained—an idea which no one examining this room ever fails to miss?

Of course, the refined character of the ornament and design in which the room abounds, plays the largest part, but careful attention is directed to the manner in which the electric lighting arrangement plays into the general scheme of the room.

Electric light is recommended to the exclusion of open flame illuminants. Its freedom from soot, its brilliance, covenience and absence of heat are exclusive features which make electric light the modern decorative illuminant.

The chief point to note is that *without a liberal installation of electric light* the effect of the room would be gloomy, instead of being quiet. The peculiar reposefulness of the *ensemble* is largely attained by the absorption of light, and provision has to be made for that.

The lighting installation consists of two electroliers before the fireplace—lighting the hearth, the pivotal point of the room. At the opposite end of the room (not shown in the sketch) is another electrolier. Side lights are disposed at intervals around the room, and a portable electric lamp is placed on the table.

This abundant lighting is absolutely necessary because the furnishings and decorations are carried out in a very low tone. If the light were not sufficient, we should get a dull, depressing effect instead of that wonderful sense of harmony and feeling of restfulness given by the softened light and blending colors.

Where the furnishings and decorations demand for their best effect the addition of a few more electric lights, to refuse to install them is like "straining at a gnat and swallowing a camel." The cost of additional current is often insignificant compared with the decorative effect achieved thereby. In every case sufficient lighting is the best economy.

Commonwealth Edison Company
139 Adams Street

Example of Dignified Advertising.

The daily newspaper advertising of the Commonwealth Edison Company, of which several examples have been given in the *Electrical World,* is prepared by the William D. McJunkin Advertising Agency under the supervision of Mr. Dana H. Howard, who is advertising manager for the Commonwealth Edison Company.

PROTECTIVE APPARATUS AND CONTINUITY OF SERVICE.

Mr. K. E. Van Kuren presented a paper at the annual convention of the Minnesota Electrical Association, in March, entitled "Protective Apparatus for Electrical Circuits and Its Relation to Continuity of Service." Mr. Van Kuren remarked, by way of introduction, that while operating companies or users should logically be the ones to give most consideration to this subject, the manufacturer is the one who is usually most on the alert, both from a research and development point of view.

In the generation, transmission and distribution of electrical energy there are two essential elements which determine its marketable value. The first is the initial cost of the delivered power and the second is the reliability of the service. The most serious cause of service interruption is, of course, lightning. Generators feeding directly out to the line should be provided with the very best protective devices available, while high-voltage oil transformers may get along with some more simple and inexpensive devices on account of the very superior insulating methods now used in the design of transformers.

Interruption of high-voltage transmission service by lightning is more commonly caused by damage to the transmission line itself than to the station equipment. The usual form of trouble is the breaking of line insulators. This grounds or short-circuits the line and sometimes burns the line conductors in two as the result of the arc formed. This kind of trouble is more common on steel-tower lines or on wood-pole lines on which the pins are metal and grounded by means of wires carried down the pole.

While a static charge is free to flow in either direction along the line, as a matter of fact the reactance of the line is such that if the potential of this charge is great enough it promptly breaks over or through the nearest insulator and passes off in a small spark. The line, in fact, may be grounded at no great distance away and yet the charge will not travel along the line to the ground, but a very large extent will pass off locally. For a frequency exceedingly high, the effective resistance of a conductor becomes many times its resistance at normal frequency, due not only to the so-called "skin effect," but to the radiation of energy in the form of magnetic waves. The result is analogous to the bursting of a pipe in which has been placed a charge of dynamite. Even though the pipe be open at both ends, the pipe will burst. Such a result, of course, will not be the case if the explosive is such that the pressure develops

slowly. The really serious result of the spark over the insulator is that the power current follows, producing a vicious arc, which destroys the insulator. If the insulators are supported on wood the resistance of the wood is usually high enough to prevent any power arc, and the initial spark passes off harmlessly if the insulators are so constructed as to flash-over the surface at a lower voltage than they will puncture.

The difficulty with wood is that wooden insulator pins will burn and wooden poles will be shattered by direct strokes of lightning. With an all-steel structure, a flash over an insulator will usually result in an arc which will wreck the insulator. One remedy is to carry the grounded metal structure up around the insulator in such a way that the arc to it will be drawn away from the insulator until the proper circuit-breakers can open and kill the line. The insulators being intact, power can be put back on the line and nothing more than a momentary interruption may result. While such interruptions may not be desirable they may be the lesser of two evils.

For the protection of apparatus, choke coils are useful to suppress high-frequency waves and prevent puncture of insulation between the first few turns of transformers or generators. The lightning arrester is essentially a safety or relief valve to permit charges of excessive potential to escape from the working conductors at a predetermined point where damage to other apparatus will not result.

After speaking of the various lightning arresters made with non-arcing metal, Mr. Van Kuren said that recent arresters of the electrolytic or aluminum type (which depends on the valve action of a film which in certain electrolytes will form on aluminum) prove much more stable under repeated discharges and are less subject to damage when used on heavy power circuits than any of the older forms. While somewhat more expensive than the old, inadequate types formerly used, the electrolytic type of arresters is made to perform this proper function perfectly and approaches more nearly the ideal lightning arrester. He then took up switching apparatus and circuit-breakers and described some forms, which were illustrated by stereopticon.

ELECTRIC GARAGE OPERATION IN BOSTON.

One of the most significant results of the awakened interest in electric vehicles at Boston last year was the establishment on Sept. 1 of a garage in the Back Bay district, devoted exclusively to electric automobile service. This installation has since been in continuous service and enjoys a growing business in its special field, being the largest electric garage in New England at the present time. The owners of the garage are the Boston Electric Garage Company, N. Rommelfanger, president, and James A. Binney, treasurer. Mr. Rommelfanger was associated with the Boston Edison Company for many years as storage-battery expert, and about a year ago, when the Electric Vehicle & Central Station Association began to press home to the public the importance of the electric commercial and pleasure vehicle's possibilities upon the superb roads of the Boston district, plans were completed for the erection of an all-electric garage at 321 Columbus Avenue, with every facility for the proper maintenance of this type of vehicle, provision for multiple charging of batteries, storage and light repairs.

The garage is located in the heart of the automobile district of the city, within a few hundred feet of the Trinity Place, Huntington Avenue and Back Bay railroad stations, and close to the Copley Square region and residential hotel and apartment house streets. About a mile north of the garage lies the main business center of the city, accessible by means of a broad and direct avenue which is almost always free from congestion. Within from five to seven minutes any electric machine housed in the establishment can be run to any point within a great commercial and residential area naturally tributary to the garage, and this point has counted heavily in the company's favor with the class of patronage which it enjoys.

The garage occupies a building four stories in height, with a basement used in battery work. The first and second floors are devoted to machine storage and battery charging; the third floor is utilized purely for storage purposes, and the fourth is given up to repair work. The garage has a frontage of 42 ft. and a depth of 100 ft., and the building construction is of the mill type with metal ceilings. Not a pint of gasoline is stored or used in the place, and consequently it was not necessary to provide elaborate precautions against fire, as in a garage caring for gasoline trucks and pleasure vehicles. At the same time, the garage was built with all electric wiring in conduit, and special care was taken to furnish fireproof doors at the elevator shaft leading from the basement to the top floor. Starting from a clientage of nil last fall the garage now has the care of about 30 cars, including storage each night, and the outlook for the open season now under way is most encouraging. Thus far pleasure vehicles predominate, there being 20 of this type in the care of the company. The ultimate capacity of the garage, including all floors, is about 150 cars. The charges for pleasure vehicles are $35 per month each, including charging of batteries, oiling, washing, correcting acid, and light adjustments. Chauffeur service between the garage and the customer's residence is supplied at $5 per month additional, per car, within one mile of the garage. The charges for caring for commercial trucks vary according to the size of the battery. Electric vehicles maintained by outsiders are charged at 7 cents per kw-hour, and the garage makes a price of 75 cents for each charge of a sparking battery for a gasoline car. A large business of this kind has developed since the owners of gasoline machines became aware of the establishment of the electric garage service.

Two electric sight-seeing machines, carrying 30 to 40 passengers each, are garaged regularly by the company, and are operated from April to October over historic routes of interest to New England visitors. These machines average about 25 miles per day, and provide a desirable off-peak load for the central-station supply service. The Edison Electric Illuminating Company of Boston furnishes the entire input of the garage, which has a maximum value of about 325 amp at 115 volts at the present time. The maximum charging load occurs between midnight and 6 a. m., although batteries are always under charge during the daytime. The pleasure vehicles maintained in the establishment are easily attaining an average daily travel of 75 miles, and the commercial wagons are in general making 40 miles per day readily. The proper charging and care of batteries and the maintenance of running gear in smooth operating condition influence this situation materially. The garage can charge 24 cars at once, through outlets provided at various points on the walls and interior columns on the first and second floors. All motor repairs are done under the general control of the garage in Boston, though not as a rule upon the premises. A special feature of the work of the garage is the building of batteries under the personal supervision of Mr. Rommelfanger. Car painting is also handled on the premises. The garage is provided with three-wire 115-230-volt service, and circuit connections are installed so that the maximum charging potential of any vehicle battery can readily be met. Cutler-Hammer rheostats are used at the charging switchboard on the first floor, from which all distribution circuits are run to the different outlets. Double-throw switches are provided for enabling instrumental readings to be made during charging. Weston and Eclipse switchboard instruments are used.

A 4-ton electric elevator, installed by the W. F. Embree Company, of Lynn, Mass., serves to transfer cars from one floor to the next. On the first and second floors are provided car-washing stands with concrete bases drained to a central outlet. These stands are each 20 ft. long and 12 ft. wide, and are lighted by three strips of border lamps made up of 20 32-cp incandescent lamps. One strip can be raised and lowered by a small pulley and tackle, and the strips are controlled by fixed sectionalizing switches mounted on the wall near the entrance of the stand. Eight men are employed at the garage, four being on duty during the day. The garage is open 24 hours per

day. In connection with the case of Edison batteries a device is in service which automatically rings an electric bell when water is poured to the proper level in the cell. Two electric taxicabs are maintained at the garage and these are giving excellent service on the streets. Each taxicab is of the single motor type and rides easier than a gasoline taxicab, the control being more flexible in crowded streets and the superior acceleration enabling faster time to be made under difficult conditions. Each cab, with average road conditions, is capable of a maximum speed of 20 miles per hour.

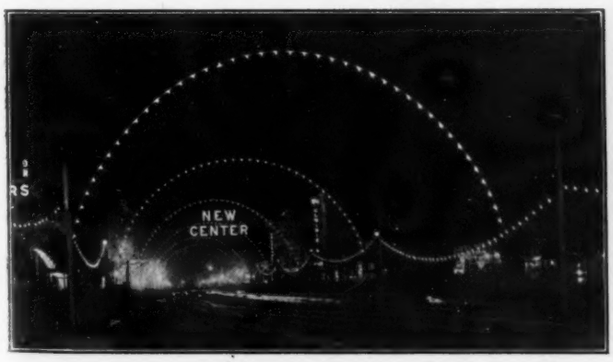
The garage has been extensively advertised in Boston and vicinity, and five billboards, 20 ft. long and 9 ft. high, have helped in this work. Each contains a picture of the garage exterior, calls attention to the fact that the establishment handles the storing, charging and repairing of machines and batteries, and also notes that the garage is an agency for a prominent make of pleasure cars. These billboards are located on first-class automobiling thoroughfares in the nearer suburbs. Theater programs have also been utilized by the company. The patronage of the garage covers such applications as department stores, flower shops, condensed milk delivery houses, lunch houses with scattered restaurants, demonstration and city delivery wagons, physicians, automobile supply dealers, and pleasure wagons.

The electric garage has demonstrated during the few months of its life that much can be done to overcome the handicaps of early unfavorable experience with electric machines in Boston by the application of specialized care to equipment now in service. By excluding the gasoline car from its precincts and confining the attention of its staff entirely to electric vehicles the best results in the use of this apparatus are obtained, and the purchaser and owner remain satisfied customers and constant consumers of central-station energy.

Wiring and Illumination

STREET ARCHES AT SOUTH BEND, IND.

About a year ago the merchants on South Michigan Street, South Bend, Ind., determined to force the center of trade to a new location and to that end erected nine arches across the street in front of their stores, as shown in the accompanying illustration. From the central arch is suspended an illuminated sign reading "New Center." The scheme proved effective, and the center of trade has since shifted perceptibly southward toward the location of the electrical display and the merchants are quite enthusiastic over the success of their venture and the



Street Arches at South Bend, Ind.

resulting increase in the volume of trade in their respective establishments. A convincing proof of this is shown by the enlarging and remodeling of several of the stores adjacent to the arches. The method of constructing the arches was outlined in detail in the March 4, 1909, issue, on page 567. At that time only one arch was erected.

COMPARISONS OF LUMINOUS AND OTHER ARC LAMP SYSTEMS.

In the luminous-arc type of lamp use is made of an electrode material which renders the arc itself highly luminous, in contradistinction to the older carbon arc where the principal source of light was the carbons, and chiefly the crater of the positive electrode. The magnetite type of luminous-arc lamp thus has the advantage of giving a uniform distribution of light in a horizontal plane, a feature which was pointed out by Mr. Louis Friedman, of Chicago (General Electric Company), in a paper read before the Missouri Electric, Gas, Street Railway and Water Works Association convention, Jefferson City, April 14.

Comparing the illumination given by various types of lamps, Mr. Friedman exhibited the following table of luminometer values, which, he said, represented the distances at which the same intensities of light were observed:

Open arc, 9.6 amp., direct-current; 285 ft.
Open arc, 6.6 amp., direct-current; 216 ft.
Enclosed arc, 6.6 amp., direct-current; 257 ft.
Enclosed arc, 7.5 amp., alternating current; 247 ft.
Enclosed arc, 6.6 amp., alternating current; 227 ft.
Luminous arc, 4 amp., direct-current; 327 ft.
Luminous arc, 6.6 amp., direct-current; 510 ft.

The comparative operating costs of these lamps per year of 4000 hours was given by Mr. Friedman as follows, exclusive of overhead charges, which, he said, should be practically the same for all systems. These cost figures are based upon a 100-lamp installation, or over:

	Open-arc, 9.6-amp., D.C.	Open-arc, 6.6-amp., D.C.	Enclosed arc, 6.6-amp., D.C.	Enclosed arc, 7.5-amp., D.C.	Enclosed arc, 6.6-amp., A.C.	Luminous arc, amp., D.C.	Luminous 6.4 amp., D.C.
Energy at 1.5 cents per kw-hr.	$50.00	$32.70	$42.90	$34.50	$30.30	$38.82	$22.80
Electrodes.....	5.50	5.50	1.20	1.50	1.20	2.85	1.55
Trimming.....	6.00	6.00	2.00	2.00	2.00	2.00	1.00
Repairs.....	2.50	2.50	1.00	1.00	1.00	.75	.75
Inner globes.....	.....	.....	.45	.45	.45	.....	.....
Outer globes.....	.30	.30	.30	.30	.30	.50	.50
Renewals in Station equipment.	1.50	1.50	1.50	.....	.....	3.00	2.00
	$68.80	$48.50	$49.35	$39.75	$35.25	$47.92	$28.60

SPECIAL STREET LIGHTING AT LANCASTER, PA.

A special street-lighting installation at Lancaster, Pa., where three distinct lighting schemes have been carried out, affords

Fig. 1—North Queen Street.

an excellent opportunity for comparing the relative value of the several lighting effects.

Two blocks on North Queen Street and one block on South Queen Street are attractively illuminated with 27 festoons of lamps, which are separated 65 ft., each carrying 40 4-cp carbon lamps, 18 in. apart. The festoons are supported by wire cables,

the ends of which are fastened to opposite poles along the street. The apex of the festoon is hung directly over the middle of the street, with the ends draped toward the sidewalk and fastened to adjacent trolley poles. They were purchased by the progressive merchants and cost $13.40 apiece, erected. The decorative and

Fig. 2—South Queen Street.

spectacular effect of this scheme evokes much favorable comment and it was particularly seasonable during the Christmas shopping period, when the lamps were first turned on.

Six Adams-Bagnall regenerative flame arc lamps deluge one

Fig. 3—East King Street.

square on West King Street with light. These lamps are 70 ft. apart, hung from suspension arms on previously erected poles 20 ft. above the street. The expense of purchase, maintenance and burning of these lamps is borne by the merchants in the

Fig. 4—West King Street.

district in which they are located. They burn nightly from dusk to 11:30 o'clock, Sunday excepted, the charge for same being $480 per year. This installation accomplishes all that could be desired in the way of a vast volume of light.

A system of street arches equipped with tungsten lamps are sending forth their cheerful glow in one block on East King Street. This installation consists of six arches each equipped with 10 75-watt, 60-cp, 18.8-volt series tungsten lamps. In this installation the Westinghouse adjuster socket system is employed, each socket being equipped with an impedance coil having the same reactance as that of the lamp filament. This feature overcomes the possibility of the circuit being broken by the failure of any lamp. The voltage is 1130, the circuit having a tap on an auto-transformer connected to a 2200-volt primary. Radial wave reflectors are used to insure an even distribution of light.

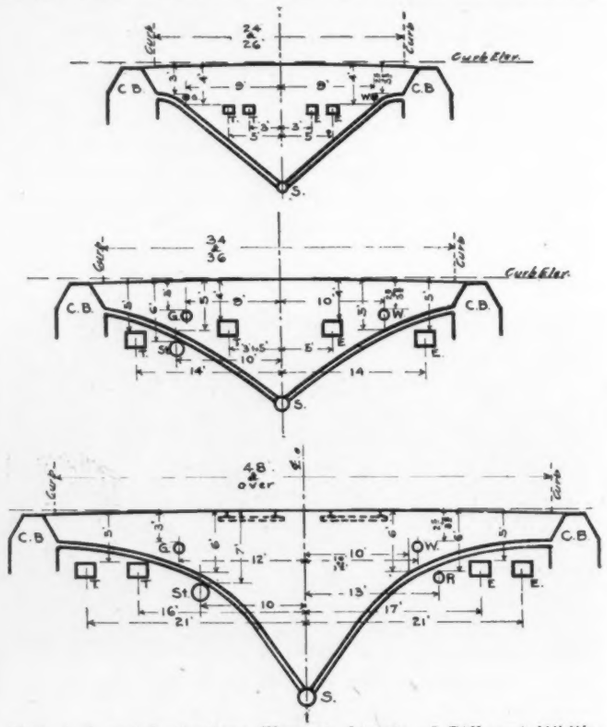
The arches were made by a local firm and cost $106 each, erected. The substantial columns or posts are of pipe 28 ft. high, 16 ft. of which is 6 in. in diameter, 6 ft. 5 in. in diameter and 6 ft. 4 in. in diameter, with 5 ft. in the ground, leaving 22 ft. above the surface. The electric construction work and equipment, complete, was executed by a local firm for $636. The price for lighting is $528 per year, making the entire installation and one year's lighting cost $1,800. The lamps are turned on at dusk and burn every night (Sunday excepted) until 11 o'clock.

This enterprise was carried out by the East King Street Merchants' Club, formed especially for the purpose, and has the unanimous support of the merchants in that square. The apportionment of the cost to the merchant is $1.50 per foot front for the erection of the arches and 5 cents per foot front per month for lighting. The collections are made by the secretary-treasurer of the club, who, by the way, is the secretary of the local Board of Trade.

UNDERGROUND CONDUITS.

By Paul P. Witham.

It has been aptly said that the overcoming of the difficulties usually encountered in laying conduits in streets already congested with subways, pipes, etc., is at once the grief and the joy of the conduit constructor. The writer, who for several



Figs. 1, 2 and 3—Sections Through Streets of Different Widths.

years has had immediate charge of the location and inspection of underground and other public-utility work in connection with the public utilities department of Seattle, has found considerable joy in an effort to prevent these difficulties. Having been in a position to observe and study such work as a whole rather

than from the standpoint of any particular interest or problem, it was perhaps easy to see the advantages of a general plan and system in the matter of the location of conduits, pipes, etc., in city streets.

At the risk of depriving the conduit constructors of the pleasure incident to overcoming difficulties, the superintendent of public utilities has provided a set of general rules and specifications governing the location and construction of underground conduits, pipes, etc., with the end in view that a place will be provided for everything and everything must be in its place.

For a number of years records of the locations and depths of all underground structures has been kept and plotted. Diagrams drawn to a scale of 1 in. = 10 ft. are used in the business and the most congested portions of the city, and to a scale of 1 in. = 50 ft. in residential portions of the city. These data have rendered it possible, when applications for permits are made, to designate just where the proposed conduit could be located without encountering existing structures. While by the use of these diagrams it was possible to avoid conflicts, it was also made clear that an orderly system was needed.

The location of the sewers and water mains (municipally owned) having been fixed by practice, the locations developed for other structures were based on that fact. The matter of depths was also largely influenced by the established practice of laying water mains with a 3-ft. cover or thereabouts. (The ground in Seattle rarely freezes deeper than 2 in. or 3 in.) It was decided, as has been the practice, to lay the gas mains at the same depth as water mains, the services from one system passing over the other. The result is that a zone, lying between a depth of 2 ft. and 4 ft. in residential districts and 2 ft. and 5 ft. in business sections, is occupied by gas and water mains. It was necessary, therefore, to require that conduits have a cover of not less than 4 ft. in residential districts and not less than 5 ft. in business sections or on main thoroughfares. An exception is made, however, in the case of small service pipes or conduits not more than 12 in. thick. Steam and refrigeration mains are required to have not less than a 6-ft. cover. The rule of "First come, first served," is applied in the matter of depths, the conduits first laid getting the advantage of the minimum depths where crossings are necessary.

The specifications are divided into sections, as follows, viz:

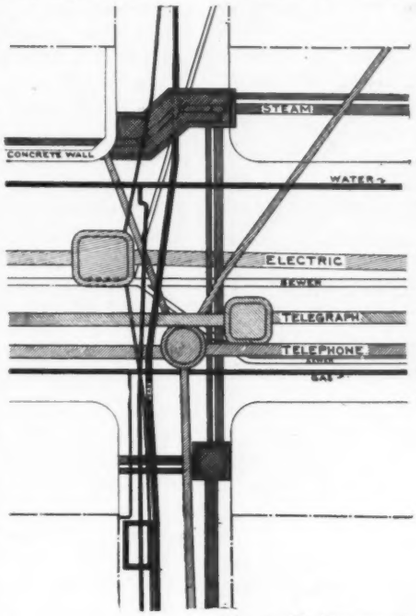
Section I. Rules and regulations applying to underground work in general.

Section II. Telephone and telegraph conduits, subdivided as follows: Locations, depths, duct materials, laying of ducts, laterals, manholes, concrete and covers.

Section III. Electric light and power conduits, subdivided as in Section II.

Section IV. Steam-heat and power mains.

Section V. Gas mains.



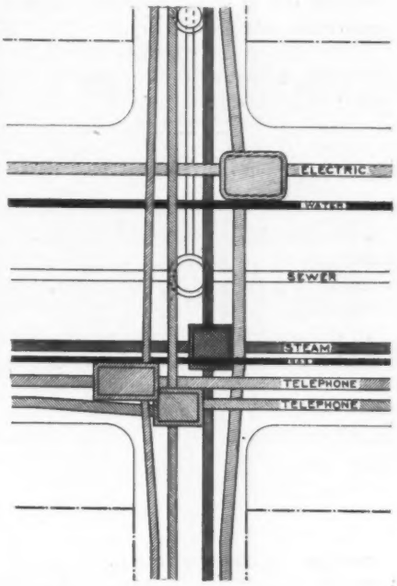


Fig. 4—Underground Structures at a Street Crossing, Actual Location.

Fig. 5—Same Structures, Systematic Location.

The location and construction of water mains and sewers is governed by specifications prepared by the city engineer. These are considered in the general plan, however. (See accompanying table of standard locations and depths of underground structures.)

While the rules have been made rather specific it was kept in mind that to be practicable it was necessary that they have elasticity. Opportunity to depart from the usual procedure is provided by a general rule on applications, which reads:

"In making application for permission to construct underground conduits, pipes, manholes, etc., said applications should state that the work is to be done in accordance with the rules and specifications adopted by the board of public works governing underground construction, unless it is desired or found necessary to perform work or use materials other than as specified in said regulations, in which case the permit shall specifically state the proposed departures, giving the reasons for the same."

The public-utility companies have not abused this rule and usually any departures requested are justified and are allowed.

It is further provided that where obstructions make it necessary to choose locations or depths other than as specified, such

GENERAL LOCATIONS AND DEPTHS OF UNDERGROUND STRUCTURES.

	Water		Sewer		Gas		Steam		Refrigeration		Telephone			Electric		
Side of Street	N. or E.		Center		S. or W.		S. or W.		N. or E.		S. or W.			N. or E.		
Width of Roadway	Location	Depth	Location	Depth	Location	Depth	Location	Depth	Location	Depth	Location		Depth	Location		Depth
											No. 1	No. 2		No. 1	No. 2	
Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*
18–22	6	2.5–3.5	CL	12–15	6	3	.....	.....	.....	.....	3	.....	*5	3	.....	5
24–32	8–10	2.5–3.5	"	12–15	9	3	.....	.....	.....	.....	3–5	.....	*5	3	5	5
34–40	10	2.5–3.5	"	12–15	9	3	5 or 10	6	.....	.....	3–5	14	*5	5	14	5
40, with Car Line same as 42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
42–46	10–12	2.5–3.5	"	15–17	12	3	10	6	.....	.....	15	18	5	15	18	5
48 and over	10–12	2.5–3.5	"	15–17	12	3	10	6–7	13	6	16	21	5	17	21	5
Alley	.....	.....	"	.....	.....	.....	2.5	5	.....	.....	2.5	5	3.5	.....	5	3.5

NOTE—Telephone and electric laterals not over one foot thick may have a 26-in. cover. In case of two telephone conduits in alley both are to be located on same side. Electric ducts and steam heat mains to be located in alleys on side opposite that occupied or reserved for telephone conduits.

*In residential districts conduits may have not less than a 4-ft. cover.

may be done by or with the approval of the superintendent of public utilities. In practice minor changes are worked out with the inspectors on the ground.

In the older districts where considerable construction is already completed, of course, the general plan can be adhered to only in part, but in the newer districts the general scheme is working out in detail with very little difficulty and rarely are departures found necessary.

The public-utility companies, realizing the advantage, are co-operating, and it is evident that no small saving in construction and maintenance costs is resulting to them and the city.

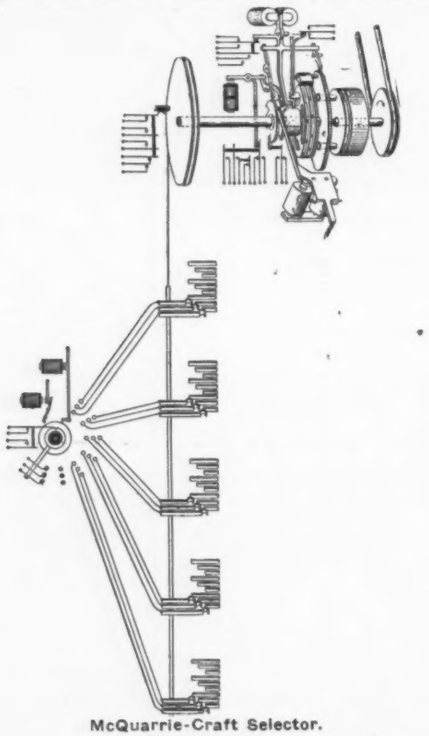
NEW TELEPHONE PATENTS.

AUTOMATIC EXCHANGES.

Rather a departure from the usual schemes for automatic exchanges is disclosed in the patent for a selector recently granted to Messrs. J. L. McQuarrie and E. B. Craft, of New York City.

In this system the line terminals are arranged in flat banks from both faces of which the connection points protrude. These flat terminal banks are made up in set units such as for 500 lines, the 100 groups occurring one over the other. There are arranged before both faces of the terminal bank several vertical guide bars. Brush carriers travel upon these bars, trailing across a vertical row of line terminals. The problem of selection lies in stopping the travel of a brush carrier with its brushes upon the proper terminals. As the distance of travel across 500 numbers would be excessive, five sets of brushes are used on each bar, held at fixed distances from each other, this arrangement being used in order to conform to the distance from center to center of hundred groups. With this arrangement the first move of a selector must be to pick out the desired hundred brush. This result may be accomplished by means of any form of rotating selector arm.

In this system the brushes are elevated by mechanical power



McQuarrie-Craft Selector.

furnished from a revolving shaft. The shaft is placed above the terminal bank, and normally the driving mechanism of the selector rides freely upon it. The driving mechanism includes a pulley to which is attached a cord fixed at its other end to the brush carrier.

When a call arrives, a magnetic clutch fixes the relation of the shaft and pulley until the desired number has been reached by the brushes. When this result is obtained the clutch is released and the pulley stops, being held by a retaining pawl.

The closing and releasing of the clutch are always timed correctly, as the mechanism which causes these is driven forward by the cord pulley and therefore has a fixed space relation to it. The clutch is in action whenever three toothed wheels have their teeth in line, so that a pawl common to all three may fall. One of these wheels has teeth on a spacing corresponding to unit motion of the brush carriage. Of the other two, one has a single tooth spaced corresponding to nine units and the second single teeth spaced 10 units apart. The last two act like a vernier, in that a disturbance of the relative angular positions of the two, throws a coincidence of two teeth, one in each, a long distance ahead. In fact, one tooth length change, throws the coincidence 10 unit teeth ahead. Therefore, it will be seen that changes in relation of these wheels correspond to tens, while co-ordinate motion corresponds to units.

Thus, to select any number, one wheel is stepped ahead a number of teeth equal to the tens, and then both are stepped together the number of units. This result can be accomplished by a single stepping magnet, driving both wheels, provided their retaining pawls are under individual control. When a number has been set, and the clutch closed, the driving mechanism winds up the cord and at the same time drives forward the common stop pawls. This latter rides upon the vernier wheels until it comes to the aligned tooth, into which it falls. At once it begins to drive the wheels and thereupon immediately releases the clutch. The patent for this selector has been assigned to the Western Electric Company. A schematic view of the selector is shown herewith.

Another patent referring to automatic working and assigned to this same company is that of Mr. A. M. Bullard, of New York City, for an energy-saving device for small automatic exchanges. In case of a ground at such a small exchange the battery might be run down unless some device were introduced to give warning. In Mr. Bullard's system, a heat coil "blows" in response to the excessive line current. Incidentally, there is energized a relay which rings upon a trunk to the nearest manual exchange. The falling of the drop attracts the operator, who, upon responding, finds a trouble hum upon the line to indicate the existence of trouble and the need of attention.

TELEPHONE SWITCHBOARD CIRCUIT.

In the two-wire system of common-battery working as originally invented, one of the line circuits was carried to the cylindrical jack sleeve, which registers with the plug shank. However, such a contact is not the best for talking circuits carrying direct currents, due to a liability of microphonic action or scratching noises. It is, therefore, well to supplement this with a spring contact. This was done by Mr. A. H. Weiss, of Chicago, in his system the patent for which is assigned to the Kellogg Switchboard & Supply Company. Another feature lies in the listening key covered by his patent. He finds that if a plug be inserted with the listening key open a test click is given the operator due to simultaneous contact of the tip and shank of the plug with the sleeve side of the jack, this resulting in operation of the busy test relay. To overcome this, the listening key is arranged to cut off the battery supply to the plug shank until after the plug is pushed home. When this is accomplished the supervisory relay restores the battery connection.

LETTER TO THE EDITOR.

British vs. American Procedure in Patent Litigation.

To the Editor of Electrical World:

Sir:—The Ilgner British patent case, noticed in your columns last week, furnishes an occasion for contrasting British and American methods of procedure in patent litigation. The issue involved was apparently considered one of much importance, judging from the eminent counsel and technical aid arrayed on the two sides. Nevertheless, the complete presenta-

tion of the case occupied the court only two days, Jan. 27 and 28, and the able and lengthy opinion of the judge was rendered a month later, on Feb. 28. Another noteworthy point is that those who gave testimony in the case were men of the highest professional authority, among the number being Messrs. Ferranti, Swinburn, Mordey and Parshall; and, moreover, all were examined and cross-examined in open court at the second and concluding session. As a contrast, reference may be made to a recent American patent case involving a relatively minor technical issue, which required five years to reach a decision in the lower court, the presentation of which was accompanied by a record of over 15,000 pages, and one stage in the litigation marked by the submittal of a list of more than 1700 questions drawn up by one set of experts for answer and rejoinder by the opposing set.

In comparison with the British method of administering justice in patent litigation, the methods which have grown up in our courts are simply preposterous and a disgrace to American jurisprudence. The manner in which such causes in this country may be drawn out amounts, owing to the expense entailed, to a practical denial of the use of patent courts to all inventors who have not behind them, directly or indirectly, powerful manufacturing interests; and the procedure with respect to technical testimony has led to a condition under which such testimony is usually given by experts without authority in the profession or art concerned, and whose essential qualification appears to be skill in befuddling the issue upon which the courts will have to pass—of expertness in the arts of *suppressio veri* and *suggestio falsi*.

New York. CHARLES L. JORDAN.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ATRICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Improving the Power-Factor of Induction Motors.—An illustrated description of the "phase advancer" of Miles Walker. The first commercial machine of this type is to be used in conjunction with a 900-hp slow-speed induction motor doing haulage work near Newcastle, England. The phase advancer is an exciter connected in circuit with the rotor winding of an induction motor, and generating magnetizing currents at the low frequency of the slip. If these magnetizing currents are great enough to create the flux in the motor, the motor will run at unity power-factor, as no magnetizing current will be required in the stator winding. If they are increased, the motor will operate with leading wattless current. In order that the current in the rotor can exercise a magnetizing effect it must be in time advance of the e.m.f. generated by the rotor slip. The necessary leading e.m.f. is generated by means of an armature revolving in a magnetic field which is excited by a leading current obtained by using the current in another phase. While the commercial machine has six pole windings, the diagram shown in Fig. 1 shows a machine with only three windings, the connections being otherwise equivalent. The main difference is that the actual machine has six mechanical poles instead of three, there being two windings and two sets of brushes in parallel in each phase. The armature resembles an ordinary direct-current railway-motor armature, except that the coil span is different. The inner end of each coil is connected to a star-point, and each outer end is connected to one bar of the commutator. On the commutator are three brushes which bear upon the segments connected to coils, which are for the time being passing under a pole. Each pole is provided with a compensating winding placed in slots in the pole face, the winding being arranged so that the ampere-wires per inch along the pole-face are equal, or slightly greater, than the ampere-wires per inch of periphery of the armature. Following one of the armature circuits, commencing from the star-point along coil 1, 2, the circuit will pass under the pole *pC*, then under pole *pB*, and it will make as many turns in front of the poles *pC* and *pB* as are necessary to generate the required voltage. It then passes to brush *bB* and on to the series-exciting coil on pole *pB*. From thence it passes to the compensating windings marked *A* in the slots *pC* and *pB*, and from these to winding of phase *B* of the rotor of the induction motor. The currents in the other phase windings pass through similar circuits. It will be seen that as the part of the coil 1 is under the pole *pC* the e.m.f. generated in coil 1, 2 will be in time advance of the current through brush *bB*. Moreover, as the part of the coil 2 is under the pole *pB* there is generated in the coil 1, 2 an e.m.f. in time-phase with the current through brush *bB*. This action gives a boosting effect in the rotor circuit, which tends to reduce the slip. By reversing the polarity of the poles or by reversing the direction of the rotation the boosting effect can be reversed so as to increase the slip. The chief difficulty in the design of the commercial machine was the fact that 1200 amp have to be collected from the commutator for each phase winding. It is a six-pole machine, and each set of brushes deals with 600 amp. The commutator is only 9 in. in diameter and has a working face of 4 in., so that most of the surface is covered by the carbon brushes. The peripheral speed of the commutator is only 2500 ft. per minute, and the wear on the brushes is very small.—Lond. *Elec. Eng'ing*, April 7.

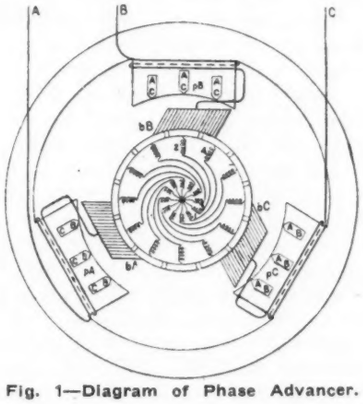


Fig. 1—Diagram of Phase Advancer.

Another illustrated description of this machine, with some editorial remarks, in which it is pointed out that in the tests the power taken to drive the phase advancer was only about 1 per cent of the output of the induction motor to which it was connected. One of the advantages claimed for an induction motor is the absence of a commutator. This, however, will no longer apply where a phase advancer is used; on the other hand, a single-phase advancer will enable an induction motor to take a leading current, and thus compensate for the lagging currents due to other induction motors.—Lond. *Electrician*, April 8.

Parallel Operation of Alternators.—H. GOERGES AND P. WEIDIG.—The authors describe an arrangement by means of which any angular displacement of one of two machines operating in parallel can be measured with great accuracy. The principle of the method depends on the use of two mirrors, *B* and *C* (Fig. 2). The axles of the two mirrors are arranged parallel to each other and the two mirrors *B* and *C* are placed on the axles. The light from the lamp *A* falls on the two mirrors and passes then into the telescope *D*. There is a possibility of light rays passing through the telescope only with a certain position of the two mirrors relative to each other and to the lamp and telescope. If the two mirrors are rotated in syn-

chronism, and if the relative position just mentioned is obtained, the light is seen in the telescope. If the correct relative position is not obtained no light can be observed. If the correct position of the two mirrors is changed by one of the machines dropping slightly out of step it is necessary to displace either the lamp or the telescope, or both, in order to see again the light in the telescope. By measuring the necessary

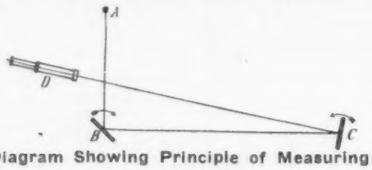


Fig. 2—Diagram Showing Principle of Measuring Device.

displacement it is possible to calculate the deviation of the machine from step. The application of the method for testing a certain machine is described in detail and the results are given in diagrams.—*Elek. Zeit.*, April 7.

Parallel Connection of Alternators.—C. F. Guilbert.—An illustrated article in which the author gives a review of recent progress in the theory and construction of dynamo-electric machinery. The author deals especially with recent work on the value of the Hutin-Leblanc amortisseur (damper) in the parallel connection of alternators—*La Lumière Elec.*, March 19 and 26.

Direct-Current Machines for Constant Currents.—E. Rosenberg.—The author criticises the recent paper of Monash on the search-lamp generators of Osnos, with special reference to his own dynamo for the same purpose. The differences between the two designs are pointed out.—*Elek. Zeit.*, March 31.

Repulsion Motor.—F. Rusch.—A highly mathematical article, illustrated by diagrams, on the theory and calculation of the repulsion motor. After giving a general analytical and graphical theory of the repulsion motor the author gives in the concluding installment the application of his method to the numerical calculation of a 100-hp motor.—*Elek. und Masch.* (Vienna), March 6 and 20.

Lamps and Lighting.

Restoring Carbon Lamps.—Schmittuz.—A paper describing a method of reviving carbon-filament lamps after they have lost part of their candle-power due to the darkening of the globe, the filament itself being still intact. The blackened lamp is opened at the tip so that air can enter into the globe. The globe is then heated by means of a flame so as to burn the black deposit on the walls. The globe is then evacuated and a suitable hydrocarbon gas is sealed into the globe. By passing an electric current through the filament it is brought to incandescence and decomposes the hydrocarbon, whereby carbon is deposited in dense form on the filament in the well-known manner. This process is continued until the filament has reached the desired thickness as determined by electrical measuring instruments. The lamp is then evacuated and the globe is closed. The lamp is then said to be as good as new.—*Elek. Zeit.*, April 7.

Internal Temperature in Mercury-Vapor Lamps.—In reply to an inquiry in the question box as to the internal temperature of mercury-vapor lamps (both quartz tube and glass tube) the following information is given: The temperature in the center of the quartz-tube lamp is estimated at from 6000 deg. C. to 7000 deg. C., at one atmospheric pressure of the mercury vapor, the center of the tube, of course, being very much hotter than the mercury vapor coming in contact with the walls of the tube; the temperature of the latter is estimated to be from 1300 deg. C. to 1400 deg. C., at one atmosphere of mercury-vapor pressure. The temperatures of the glass-tube lamp are very much lower and are, in the normally operating lamp, between 160 deg. C. and 290 deg. C.—*Elec. Journ.*, April.

Effect of Ultraviolet Rays on the Eyes.—A. Vogt.—The author criticises the claim made by Schanz and Stockhausen that it is necessary to protect the eye against ultraviolet rays of an artificial source of light by means of "euphos glass." The author shows that yellow glasses of similar composition as euphos glass which absorb the ultraviolet light very perfectly have long been well known. However, this yellow-green glass when used in spectacles is disagreeable and will never be suitable for illuminating purposes because a considerable amount of light rays is absorbed. If it were necessary to weaken modern sources of light by means of such yellow-green glass globes it would be better to go back to the kerosene lamp. The author criticises the statement of Schanz and Stockhausen that ultraviolet rays with a wave-length around 390$\mu\mu$ are specially detrimental. He shows that ordinary daylight always contains these rays and has never had any bad effect on the eyes. The author sees no reason for any protection.—*Arch. f. Augenheilkunde*, Vol. 64, No. 4, page 344; abstracted in *Elek. Zeit.*, April 7.

Generation, Transmission and Distribution.

Trollhattän Power Station.—An article on the present development of water-power at Trollhättan. There could be developed 200,000 hp, but for the present only part of this is to be utilized. In the first plant there will be eight turbines having a total of 80,000 hp, four of which have already been installed. They are coupled to three-phase generators rated at 11,000 kva, 10,000 volts and 25 cycles. Three small turbines coupled to direct-current generators, each of 500 hp and operating in parallel with a storage battery of 5800 amp-hours, supply energy to the lighting network and exciting circuits at 220 volts. The excitation of the three-phase generators can be changed between 0 volt and 330 volts by means of boosters driven by the turbines. The energy is distributed partly at 10,000 volts and partly transmitted at 50,000 volts. The first cost of the 80,000-hp power station is $2,875,000.—*Elek. Zeit.*, April 7.

Swiss Water-Power Plant.—A note stating that during the last two or three years the hydroelectric power station on the left bank of the Rhine at Schaffhausen, in Switzerland, known as the Wasserkraftwerk B, has been altered and enlarged without any interruption of supply. The available head varies between 12 ft. and 16 ft. About 1400 cu. ft. of water were utilized per second in the four turbines, each of which had an output of 300 hp, a good deal of the water being lost owing to various causes. In accordance with the suggestion of Professor Prasil, of Zurich, five Francis double turbines, with vertical shafts, each of 550 hp rating, when working at 15-ft. head, have now been erected. When the water level is low and a head of nearly 16 ft. is available, the upper wheel alone is kept running. With a flow of 420 cu. ft. of water per second 550 hp will be developed. The lower wheel is meanwhile kept closed, and runs in the suction shaft in air, not in water. When the water level is high and the available head is not more than 13 ft., the lower wheel alone is employed. It can develop 520 hp using 500 cu. ft. of water per second. The upper wheel has a height of 22 in., the lower 25½ in. Another weir is to be erected in the Rhine; the available head will then be 18 ft. and the upper wheel alone will, with a rate of flow of 280 cu. ft. per second, yield 450 hp. The 1400-cu. ft. of water per second would, with the new plant, develop 2250 hp.—Lond. *Electrician*, April 8.

Commercial Prospects of Water-Power Plants.—W. von Winkler.—The author discusses the commercial prospects of larger water-power plants in Austria. He emphasizes that a concession by the State extending over only 50 years is too short. The concession should extend at least 90 years. He also urges that any further propositions to put any tax on water-power should be strongly opposed.—*Elek und Masch* (Vienna), April 3.

Electric Power in Collieries.—An illustrated description of the electric equipment of the Ashington collieries, near Newcastle, England. The total output of these mines amounts to about 2,000,000 tons per year. The company generates its own electric energy in a steam station. The total installation is rated at about 2200 hp, distributed among about 80 motors.—Lond. *Elec. Eng'ing*, April 7.

Electricity in Collieries.—An article on the duties of a colliery

electrician, with notes on the maintenance of colliery electrical plant, and proposed modifications of the special rules in force in England.—Lond. *Elec. Eng'ing,* April 7.

Cranes.—H. H. BROUGHTON.—A continuation of his illustrated serial on electric crane arrangements. The author deals with traveling cranes with inverted jibs; traveling cranes with inverted jibs and traversing trolleys, and traveling cranes with single trolley and turn-table.—Lond. *Electrician,* April 8.

Traction.

Electric Braking and Automatic Sanding.—A. GERRARD.—A paper read before the (Brit.) Inst. Elec. Eng. on progress of electric braking on the Glasgow Corporation Tramway system. The author shows that the Newell brake with the old type of magnet is greatly superior to the rheostatic brake, both in retarding force and in energy consumption; however, the voltage generated during high-speed braking is excessive. The Newell brake with parallel shoe magnets is easier on the motors than the old type of magnets, and would be quite satisfactory were it not for the high voltage and skidding at high speeds. These disadvantages are eliminated in the Newell brake with parallel shoe magnets and solenoid-controlled shunts to the motor field coils. Reference is finally made to an automatic sanding apparatus, the component parts of which are a solenoid and a continuous-flow sand valve. The coil of the solenoid is inserted in the main braking circuit, and its armature is connected to the continuous-flow sand valve, so that when the solenoid operates the sand valve is opened and a copious supply of sand is projected on the rail without any effort of the motorman. A spiral spring is attached to the valve in such a way as to work against the action of the solenoid, and adjusted so that if the electric brake is applied for an ordinary service stop, or for coasting, the solenoid is prevented from opening the valve and wasting sand when it is not required; in the event of the motorman making an emergency stop the current through the circuit is sufficient to operate the solenoid and to supply sand automatically.—Lond. *Electrician,* April 8.

Single-Phase Traction in France.—An account of the project of single-phase traction on portions of roads of the Railway Company du Midi. There will be four water-power plants with a total rating of 38,000 kw, producing single-phase current with a frequency of 17 cycles per second for the transmission of energy at 6000 volts to five substations. In these substations the e.m.f. is to be reduced to 12,000 volts, which will be the pressure on the trolley wire. Both motor-cars and electric locomotives will be used, the former on branch lines on which the traffic is not very heavy.—*L'Industrie Elec.,* April 10.

Suspension of Traction Motors.—R. VAN CAUWENBERGHE.—The author asks whether there are mechanical reasons for the method, generally employed, of the suspension of traction motors, and he answers this in the negative. He then asks whether it is correct to place the suspension springs at the point of center of gravity of the motor. Since the suspension springs are intended to attenuate the shocks, they should be placed at the center of rotation rather than at the center of gravity.—*La Lumière Elec.,* April 2.

Operating Costs of Electric Railways.—An abstract of a report by G. Gibbs on the operation of the Long Island Railroad and the West Jersey & Seashore Railroad under electrical working. Particulars are tabulated of the energy consumption, costs per car-mile, defects of train equipment, and the delays due to failure of the electric equipment.—Lond. *Electrician,* April 8.

Inspection.—M. B. LAMBERT.—An article discussing the routine methods of inspection of car equipment on electric railways.—*Elec. Jour.,* April.

Installations, Systems and Appliances.

Central-Station Statistics for Switzerland.—An account of the status of central stations in Switzerland at the end of 1908. The number was 636, against 607 in the preceding year. Of these 235 stations produced all the energy themselves, 57 produced part of it, and 344 bought their energy from another power station. Fifty-one per cent used water-power, 37.6 per cent water and steam power, 2.8 per cent steam power, 7.4 per cent gas, and 1.1 per cent steam and gas. The mean cost of installation per kilowatt (not including the storage batteries) is $133 for the prime movers and $121 for the electric plant of those stations which have their own power plant and $119.60 for those stations which receive energy from another power plant. The cost of installation per kilowatt varies from $79 to $214.40 for the prime movers. The mean cost of prime movers per kilowatt is $113.40 in the water-power plants, $140.60 in water and steam plants, $171 in steam plants and $207 in gas-engine plants. Twenty-five per cent of the stations use direct current, 25.3 per cent single-phase alternating current, 3.2 per cent two-phase currents, and 46.3 per cent three-phase currents. Of the alternating-current plants 17 use e.m.fs. between 1000 and 2000, 53 between 2000 and 5000, 34 between 5000 and 25,000 and 1 (Thusy-Hauterive) 32,000 volts. There are five installations using the direct-current series system, the e.m.f. varying between 5000 volts and 25,000 volts. Sixty-nine per cent of the alternating-current stations use a frequency of 50 cycles; in the others the frequency varies from 33 to 60. The total number of transformer stations is 4532, the number of transformers is 7653, their total rating 194,200 kw.—*L'Industrie Elec.,* April 10.

Paris.—A. TROLLER.—An account, based on official data, of the rapidly progressing rearrangement of electricity supply in Paris. The new system comprises three different zones of distribution. The first zone is the center of Paris, with dense population and a large consumption of energy and is supplied by a direct-current system through five wires or three wires. The second zone, which contains the west of Paris, where the population is less and the consumption smaller, will retain the system of distribution used at present, namely, single-phase current at 3000 volts. The third zone covers the northeast, east and southeast of Paris, where there is practically no distribution at present and where the density of population at present is very small. A two-phase system at 2 × 110 volts is to be used. Some notes are given on the substations and cable network.—*La Lumière Elec.,* April 2.

Ratings of Single-Phase Transformers for Grouping of Polyphase Circuits.—H. C. SOULE.—An article illustrated by diagrams in which the author analyses the various possible groupings of single-phase transformers on polyphase circuits and explains why certain groupings should have transformers of larger kva rating than would be indicated if the rating of each unit were determined by dividing the kva rating of the group by the number of transformers comprising the group. The chief results are as follows: (A) With three single-phase transformers, star-connected, the individual unit kva rating equals one-third group rating. (B) With three single-phase transformers, starconnected, the individual unit kva rating equals one-third group rating. (C) With two single-phase transformers "V" or open-delta-connected the individual unit kva rating equals one-half group rating multiplied by 1.155, or approximately 58 per cent of the group rating. (D) With two single-phase transformers T-connected for three-phase transformation the individual unit kva rating equals one-half group rating multiplied by 1.155, or approximately 58 per cent of the group rating. (E) When two single-phase transformers are to be connected for three-phase to two-phase transformation, especially designed transformers should be used, each transformer having the winding to be connected three-phase designed for a kva rating equal to one-half the group rating multiplied by 1.155, or approximately 58 per cent of the group rating. The secondary windings of each transformer should be designed for a rating equal to one-half the group rating.—*Elec. Jour.,* April.

Operation of Delta and V-Connected Transformers in Parallel.—E. C. STONE.—The author gives a table containing a summary of the transformer ratings available with various combinations of V (open-delta) and delta groups of transformers. Some of the facts brought out by the table are as follows: More than one V-group of two transformers can-

not be used advantageously with a delta group of transformers nor with two or more parallel delta groups. Three delta-connected transformers when added to another group will provide an increase of 50 per cent greater than four transformers connected in two V-groups and added to the same delta group. This relation is true because the four transformers which would form two V groups can be rearranged to form a delta group (one transformer remaining idle), and the delta group will have the rating of three transformers, while the two V-groups will add the rating of only two transformers. The article is illustrated by diagrams.—*Elec. Jour.*, April.

Aluminum-Cell Protective Devices.—A note on a recent British patent (10,594, 1909; March 31, 1910) of the British Thomson-Houston Company (General Electric Company of this country). In order to equalize the voltage across a number of cells connected in series the electrolytes of the successive cells are electrically connected by glass tubes filled with the electrolyte and placed in shunt to the aluminum electrodes. The tubes are made U-shaped and form siphons from cell to cell. To prevent bubbles of gas from breaking the connection, each tube is provided at the top with a gas chamber.—Lond. *Elec. Eng'ing*, April 7.

Harmonics in Transmission System.—E. Caudrelier.—The author shows that in transmission systems which contain non-synchronous motors or generators there are produced higher harmonics which are not an exact multiple of the frequency of the fundamental wave.—*La Lumière Elec.*, April 2.

Electricity in Laundries.—An illustrated description of an electrically driven hydro-extractor for use in laundries. This machine comprises a circular "basket," in which are placed the materials to be dried. The basket has a wall of perforated metal and is rotated at a high speed, so that most of the water in the material is thrown out by centrifugal force.—Lond. *Elec. Eng'ing*, April 7.

Iron-Wire Rheostats.—F. Loppe.—An article giving the formulas for calculating the dimensions of rheostats made of iron wire.—*L'Industrie Elec.*, April 10.

Concrete Switch Structures.—S. U. Hayes.—An illustrated description of various continental European examples of concrete construction of switch-gear compartments.—*Elec. Jour.*, April.

Wires, Wiring and Conduits.

Static Strains in High-Tension Circuits.—P. H. Thomas.—The conclusion of his article on this subject. The results are summarized as follows: When a "dead" transformer is connected to a live line a strain may be produced on the layers of the coil next to the terminal, which may be as great as the line voltage. When a short line is charged suddenly from live busbars there may be produced a momentary voltage rise which will be not more than double voltage. When a long line is charged a strain similar to that in the short line is produced doubling the potential first at the end of the line and afterward along the whole length. This result assumes that the charging terminal of the line is abruptly raised to full normal potential and rigidly maintained there until the wave is fully formed, and that the losses are zero. The fundamental principles governing the charging of a cable are the same as those of a transmission line. Opening an unloaded high-tension circuit may be nearly the equivalent of charging the circuit, since before the line is completely freed from the busbars it is often momentarily recharged several times. When a branch of small electrostatic capacity is supplied with energy from a main line, the rise of potential at the farther end may be twice as great as at the end of the main line. In addition to switching, other causes of static strains are grounding, short-circuiting, lightning, etc., when these cause abrupt changes of potential. A rise of potential due to resonance is always possible, but generally improbable. It requires that there be an oscillating circuit and an exciting cause which must be of very nearly the same frequency as the natural period of the oscillating circuit. When an alternating e.m.f. of high frequency is applied to a long line the danger that resonance will occur is usually greatest, as it may be produced by a large number of frequencies. High-voltage transformers should be so designed as to possess a good and constant factor of safety both in the outlet terminals and between turns of the parts of the winding which are next to these line terminals. This can usually be accomplished by providing extra insulation on the end portions of the windings, and by eliminating all voltage taps from these parts of the windings, confining them to the inner turns of the windings.—*Elec. Jour.*, April.

Copper.—L. Odendall.—A continuation of his statistical article on copper production in the United States. In the present installment data are given on the labor cost and the financial results obtained by the largest mining companies in the Lake Superior district. A sketch is then given of copper mines and smelting plants in Arizona.—*Elek. Zeit.*, April 7.

Electrophysics and Magnetism.

Tractive Force of Electromagnets.—A. Berninger and R. Edler.—The authors give an account of further experiments on the tractive force of electromagnets with different excitation and variable air-gap; that is, they measure that force which attracts the armature from a certain distance and not the force with which the attracted armature is held by the magnet. They also investigate in some detail the distribution of the lines of force in iron of the electromagnet.—*Elek. und Masch.* (Vienna), March 27 and April 3.

Electrochemistry and Batteries.

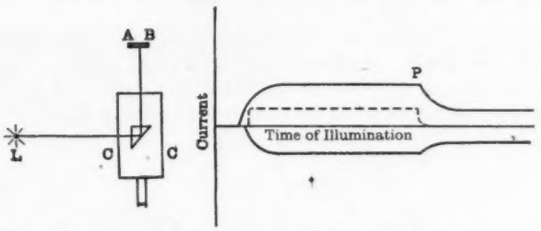
The Electric Furnace in the Iron and Steel Industry.—V. Engelhardt.—To determine whether the electric furnace can compete with the blast furnace for iron-ore reduction, it must be considered that the blast furnace requires 100 per cent of coke figured on the pig iron produced, while the electric furnace requires only 30 per cent, with 2000 kw-hours of electrical energy. Hence, only when the cost of the latter is less than the saving in the cost of coke is the electric furnace more economical. Under present conditions this is the case only in special localities with cheap water-power and expensive coke. The electric steel refining process is greatly superior to the crucible steel process on account of reduced cost. The electric steel process is bound to become more important as an accessory to Bessemer-converter and open-hearth plants since with a slightly enhanced cost it is then possible to produce a greatly improved steel. In some cases dephosphorization and desulphurization in the electric furnace is not even necessary since the mechanical properties of the steel can be improved simply by resting in the furnace, whereby the gas bubbles and slag enclosures have a possibility to rise to the top of the charge. At present 100 electric steel furnaces are in operation, of which 66 are arc furnaces and 34 are induction furnaces. Most of the furnaces have a rating of from one to five tons. The largest rating of an induction furnace is 10 tons. The largest rating of two American arc furnaces is 15 tons. The total charge of all electric steel furnaces at present in operation and in construction is estimated to be 350 tons with an aggregate power consumption of 50,000 kw.—*Elek. Zeit.*, April 7.

Units, Measurements and Instruments.

Magnetic Testing.—In the report of the (British) National Physical Laboratory some work done by Campbell on magnetic testing is mentioned. The ring form of the magnetic circuit, often used in magnetic testing, is open to objection. When the ring is radially small, the edge deterioration due to stamping is considerable, and annealing furnishes a questionable improvement. The radial width is comparatively large, the magnetic force H varies considerably over the width of the ring. Hence the preference for the method of J. Epstein, in which the sample is in the form of four bundles of strips assembled into a square or rectangle with butt joints; in this case the leakage due to the joints is considerable. M. G. Lloyd and J. V. S. Fisher (Bureau of Standards, 1908) make the strips wide, and insert short angle bars of the same material at the ends, so as to interlace the strips which form the sides of a rectangular box at the joints. Campbell finds this method advantageous in measurements made with a wattmeter at 50

cycles. The losses were generally smaller than with the ring methods; for very thin and hard sheets the two methods were in fair or complete agreement. It is hoped to secure international co-operation in this work.—Lond. *Engineering*, April 8.

Selenium.—T. Thorne Baker.—In various systems of photo-telegraphy a beam of light from a lamp *L* (Fig. 3) traverses a transparent photograph wrapped round a glass cylinder *CC* and falls upon a selenium cell *AB*, the intensity of illumination



Figs. 3 and 4—Silenium in Photo-Telegraphy.

at *AB* varying at each instant according to the density of the photograph. The two troubles with the cell are time lag and condition lag. By a compensation method of Korn it is possible to cause the selenium to respond rapidly and precisely to any alterations in the light falling upon it. Two selenium cells are arranged on two opposite sides of a Wheatstone bridge, and both are illumined simultaneously, so that the movement obtained in a galvanometer is proportional to the difference of the reciprocals of the resistances of the two cells. When the two selenium cells are properly chosen (one with great sensitiveness and low inertia and the other with small sensitiveness and high inertia) almost perfect compensation can be obtained. The net result of casting a sudden illumination on the two cells is shown by the dotted line in Fig. 4, which is the difference of the two curves of the two cells, shown by drawn-out lines. When the illumination of the two cells is abruptly stopped, the current drops at once to zero, whereas with one cell alone the altered physical condition of selenium would be maintained for perhaps two or three seconds. A similar scheme may be employed to transform a wireless oscillation of, say, 10^{-b} amp, to any desired amount of power. The oscillation, after being suitably transformed, is passed through a detector, and thence into a string galvanom-

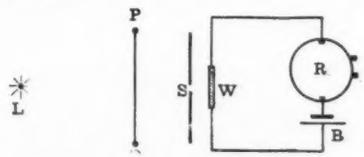


Fig. 5—Silenium in Photo-Telegraphy.

eter, of which the fine string *PQ* (Fig. 5) is free to move laterally in a powerful magnetic field. The illumination from the lamp *L* causes a shadow of *AB* to cover the slit *S*, so that no light falls on the arrangement of compensated selenium cells *W*, which is connected in series with the battery *B* and sensitive relay *R*. When the current passes through *PQ* it causes the wire, fiber or string to be laterally displaced, hence its shadow falls away from the light, and light reaches the compensated cells at *W*. Current is then established through the relay *R*, from whose local circuit any desired amount of power can be electrically set in motion. This method is particularly applicable to wireless photo-telegraphy.—Lond. *Electrician*, April 8.

Lorenz Apparatus.—In the report of the (Brit.) National Physical Laboratory it is stated that the Lorenz apparatus is now completed and that the work of the absolute determination of the ohm will be taken up by Smith. The principle of the Lorenz apparatus is the following: Within the coil of n turns, through which there is a current i, is turned a metallic disk of radius r at N revolutions per second; contacts bear against the center and against the circumference of the disk. An e.m.f. will be induced, since the disk area $Nr^2\pi$ cuts $4\pi niNr^2\pi$ lines of force. The induced current is sent through a resistance R so as to balance the current i, then $Ri = 4\pi niNr^2\pi$ or $R = 4\pi Nr^2$. In the few Lorenz apparatus so far constructed the disk turns within one coil. Mr. Smith has placed the disk between the two coils so that the edge of the disk is outside the field. There is then no flux density at the circumference of the disk, the calculations of the thermal force and mutual induction between cores and shaft become simpler, and the r need not be known very exactly; this is an important point, as some kind of brush contact has to be provided for the circumference. The whole apparatus is, moreover, in duplicate; that is to say, there are two disks and two pairs of coils, all four in series. Each coil consists of one layer of copper wire only, placed in grooves of a marble cylinder on the inside of the cylinder; these cylinders were made and measured in the laboratory. The four coils rest on piers; the phosphor-bronze shaft runs right through all the coils, carrying the two disks as well, of course. At the far end of the shaft is the electric motor for 1000 revolutions. A chronograph belongs to the apparatus. The shaft runs in three bearings, which are insulated by means of stabilit; the induced e.m.f. will be only about 0.25×10^{-4} volt. The bed on which the apparatus is erected is a layer of Keen cement, 3 ft. in thickness, 24 ft. long. Experiments as to the construction of the driving electric motor have been made by A. Campbell. An hydraulic motor would have been inconvenient, but the effect of the electric motor on the mutual induction of the coil and disk had to be minimized. Large masses of laminated iron were placed at various distances between the motor and the apparatus proper, and it was found that the effects were negligible when the motor was 8 ft. from the nearest coil. To make the effect less than 1 in 1,000,000—an accuracy of 1:100,000 is desired for the determination—an "image" pair of coils will be mounted beyond the motor.—Lond. *Engineering*, April 8.

Calorimeter.—In the report of the (British) National Physical Laboratory mention is made of a new Fery recording calorimeter for power-gas testing. A flame of the respective gas, fed through a flow-meter and pressure regulator, burns within a frame built up of strips of thermocouples. The thermo-e.m.f. is recorded or read off, and the calorific value of the gas is thus ascertained by a continuous test.—Lond. *Engineering*, April 8.

Electric Localization of Cable Breaks.—E. Raymond-Barker.—An illustrated description of the use of the Gott-Raymond-Barker curve sheet for the electric localization of cable breaks by Jona's graphical method.—Lond. *Elec. Rev.*, April 8.

Telegraphy, Telephony and Signals.

Inductive Effects upon Telegraph and Telephone Lines of High-Tension System of Rhenish Prussia.—O. Brauns.—This system serves Crefeld and district, and the exchange is on the railway between Duisburg and Cleves. Three-phase currents are generated at 5000 volts, 50 cycles, the e.m.f. being raised to 10,000 volts for the transmission of energy over 12 km (7 miles) by overhead wires to Hohenhudberg. It is intended to raise the e.m.f. to 20,000 volts. The paper describes at great length and with minute exactitude the observations taken upon the adjacent telegraph and telephone circuits with a view to quantitative record of the disturbance values. The author has constructed theoretical formulas from which the nature and extent of such disturbances could be predicted, and the observed results agree remarkably with those calculated from the formulas. During the course of the experiments the three-phase transmission lines were (1) placed vertically one above the other, (2) arranged in triangular position, and (3) the neutral point was earthed, observations being taken on the contiguous circuits under all these conditions. As showing the order of such disturbances as were experienced, and the close agreement between prediction and fact, the following instances are quoted: (1) Between Hohenhudberg and Mors stations, 9.47 km, the high-tension line is on one side of the railway and the telegraph line on the other, the distance apart of the two lines being, say, 9 m (30 ft.) on an average. The wires of the high-tension line were crossed in two places. One phase wire was earthed and the nearest telegraph line was

joined to earth through 10,000 ohms. There was then induced 53.5 volts and 5.50 milliamperes. The calculated current was 5.08 milliamperes. With resistance to earth of 2000 ohms, the values observed were 11.6 volts and 5.76 milliamperes, the calculated current was 5.99 milliamperes. On a length of 2.74 km in the case of another telegraph wire, slightly more distant than the first, the three-phase lines not being anywhere crossed and the telegraph line earthed through 100,000 ohms, the induced volts were 7.60 from one phase, as observed, and as calculated 5.78; from the other phases, 10.18 and 8.50, respectively. The author finds a remedy, to a great extent, for the disturbance in the telegraph lines by introducing condensers between line and earth. The effect is very remarkable. On the section of the line above mentioned the induced volts from two of the phases were 14.2 and 20.9, respectively, without condensers. The effect of adding capacity was as follows: With 0.01 mf, 9.7 volts and 14.5 volts; with 0.05 mf, 4.3 volts and 6.3 volts; with 0.10 mf, 1.61 volts and 2.43 volts. Such added capacity is not unlikely to affect the speed of telegraphic transmission, especially as it is not uniformly distributed along the line. The author proposes to counteract the speed effect by the use of inductances. As regards telephone circuits, the author recommends their removal as far as possible from the region of danger. Diagrams are given in the original which show the lines upon which the experiments were carried out and their geographical positions.—*Archiv. Post Tel.*, 22, page 693, November, 1909; abstracted in *Science Abstracts*, B, Jan. 31.

Sterilization of Water by Ultraviolet Rays.—A. Soulier.—Since it is easy now to produce ultraviolet rays by means of the quartz-globe mercury-vapor lamp, it is proposed to use the sterilizing effect of these rays for the purification of water, milk, etc. A form of lamp suited for this purpose is shown in Fig. 6 and the arrangement for water sterilization is shown in Fig. 7. The water enters at the point *A* and leaves at the point *C*. Its passage through the apparatus is indicated by the arrows. The mercury-vapor lamp with quartz globe is shown at *B*. An apparatus of this kind sterilizes 600 liters of water per hour and

Fig. 6—Form of Mercury Vapor Lamp.

requires 305 amp at 100 volts, or 0.6 watt-hour per liter of water sterilized. Recently Geissler tubes made with quartz globes have also been used for this purpose. Another source of light

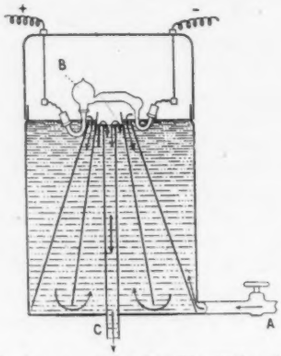


Fig. 7—Arrangement for Sterilizing Water.

very rich in rays of wave lengths from 1860 to 2900 Angstrom units, is an arc between two electrodes made of mixtures of alumina and carbon in equal portions.—*L'Industrie Elec.*, April 10.

New Apparatus and Appliances

THE EDISON STORAGE BATTERY.

Its Pre-eminent Fitness for Vehicle Service.

By Walter E. Holland.

The "A"- type Edison cell is the outcome of nine years of costly experimentation and persistent toil on the part of its inventor and his associates. Developed by the slow process of elimination, it has survived thousands of other thought-of types—the fittest in its chemical nature, in mechanical construction and in electrical worth.

The Edison invention involves the use of an entirely new voltaic combination in an alkaline electrolyte in place of the lead/lead-peroxide combination and acid electrolyte characteristic of all other commercial storage batteries. Experience has proven that this not only secures durability and greater output per unit-weight of battery, but in addition there is eliminated a long list of troubles and diseases inherent in the lead-acid combination, which have hitherto hindered the full application of the original storage-battery idea.

The principle on which the action of this new battery is based is the oxidation and reduction of metals in an electrolyte which does not combine with, and will not dissolve, either the metals or their oxides; and an electrolyte, furthermore, which, although decomposed by the action of the battery, is immediately re-formed in equal quantity and, therefore, in effect is a *constant* element, not changing in density or in conductivity.

A battery embodying this basic principle will have features of great value where lightness and durability are desiderata. For instance, the electrolyte being a constant factor, as explained, is not required in any fixed and large amount as is the case with sulphuric acid in the lead battery; thus the cell may be designed with minimum distancing of plates and with the greatest economy of space that is consistent with safe insulation and good mechanical design. Again, the active materials of the electrodes being insoluble in, and absolutely unaffected by, the electrolyte, are not liable to any sort of chemical deterioration by action of the electrolyte, no matter how long continued.

Those who have had experience with lead batteries know what attentive care is required to prevent "sulphation"—that

Fig. 1—The Two Types of Perforated Containers Into Which the Iron and Nickel Active Materials Are Loaded.

"white plague" of the lead-cell world, which is caused by chemical action of the electrolyte on the active materials. They will also appreciate that such a disease-free battery as this, is the augury of a beneficent revolution in electric-vehicle practice.

The electrolyte of the Edison battery is a 21 per cent solution of potassium hydrate having in addition a small amount of lithium hydrate. The active metals of the electrodes—which will oxidize and reduce in this electrolyte without disso-

lution or chemical deterioration—are nickel and iron. These active elements are not put in the plates *as metals,* but one, nickel, in the form of a hydrate, and the other, iron, as an oxide.

The containing cases of both kinds of active material (Fig. 1) and their supporting grids (Fig. 2), as well as the cell pole with its connection parts (Fig. 3), and even the retaining can and its cover (Fig. 4), are all made of nickel-plated steel, a material in which lightness, durability and mechanical strength

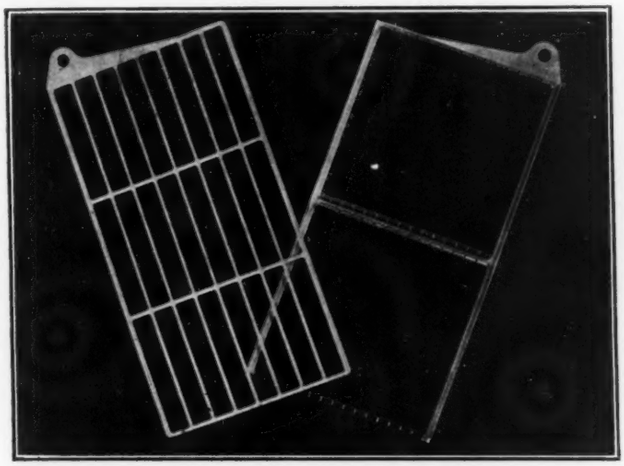


Fig. 2—The Two Types of Supporting Grid.

are most happily combined, and a material beyond suspicion as to corrosion in an alkaline electrolyte. Apparently an accident, it seems more like the working of a kind Providence, that the materials discovered by Edison as fulfilling the chemical and electrical requirements of an ideal storage battery, should also have the most-desired physical properties—strength, lightness and facility of manipulation—and at the same time should meet the commercial requirement of inexpensiveness.

An essential part of Edison's discovery of active materials for an alkaline storage battery was the *preparation* of these materials. Metallic powder of iron and nickel, or even oxides of these metals, prepared in the ordinary way, are not chemically active in a sufficient degree to work in a battery. It is only when specially-prepared iron oxide of exceeding fineness,

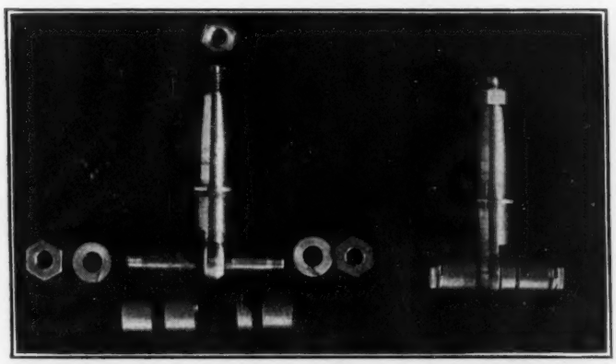


Fig. 3—Cell Poles and Their Connection Parts.

and nickel hydrate conforming to certain physical as well as chemical standards can be made that the alkaline battery is practicable. Needless to say, the working out of the conditions and processes of manufacture of materials has involved great ingenuity and endless experimentation.

Having discovered the basic elements of the alkaline storage battery, the inventor set about to find the best means of supporting and making electrical connection with the active materials and to perfect the mechanical design. It was found, as expected, that the active materials were not of themselves sufficiently conductive to work efficiently except in exceedingly thin layers. Some conducting substance which would not be changed by chemical action must, therefore, be mixed with the active materials to bring every particle into good electrical contact with the conducting support.

Graphite was first thought of, and was tried, both with the iron and with the nickel material. At first it gave only fair results, but after a particular quality in the form of thin scales had been developed the results were good. It was soon superseded in the iron electrode, however, by mercury, which was found to hold the iron particles in much better contact and give better voltage to the cell at high discharge rates.

In the nickel electrode, graphite was used until the recent advent of the "A"-type cell. The results as to capacity were good when cells were new, showing that graphite performed well the function of bringing every particle of the active nickel into good electrical contact with the conducting support. But, unfortunately, in time it became apparent that this most durable form of conducting carbon was unable to withstand the disintegrating action of the strong oxidizers formed at the nickel electrode during charge. The result was that cells of this type, in service, would gradually lose capacity from deterioration of internal contacts in the nickel plates.

One other feature of the former types of this cell remains to be commented on as a point contributory to their deterioration. It is a bothersome characteristic of all storage batteries that the active materials expand and contract during charge and discharge of the cell. This point was not properly taken care of in the first types produced, although much attention had been given to it. In the "E"-type, the immediate predecessor of the "A", flat, rectangular containers (like those used in the iron plate to-day) were used for supporting *both* kinds of

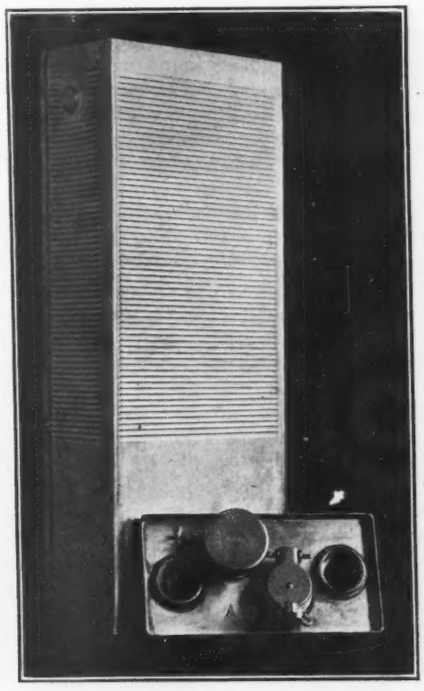


Fig. 4—Retaining Can and Cover.

active material. These containers, after loading and mounting in a support grid, were subjected to heavy pressure in a die designed to concave and corrugate each loaded container, or pocket—the idea being to make an elastic construction which would maintain a constant spring pressure on the active materials. In the iron plate this construction proved perfectly satisfactory, and, as mentioned, is still used.

The nickel material proved more troublesome, however. It would expand when charged and would not contract again; and its expansion was found to be cumulative, increasing gradually in extent until, in time, the elastic limit of the per-

forated steel was exceeded, and the internal contacts became disarranged.

Notwithstanding these facts, the "E"-type Edison cell, with nickel plates of flat-pocket construction and containing graphite, was used in commercial service with excellent results—having a useful life of from three to five years, and showing itself to be more economical than the lead battery and much more dependable.

Such results would have delighted any ordinary inventor; not so Edison! He held a prophetic vision of the ultimate value to humanity of his *perfected* battery, and would be satisfied

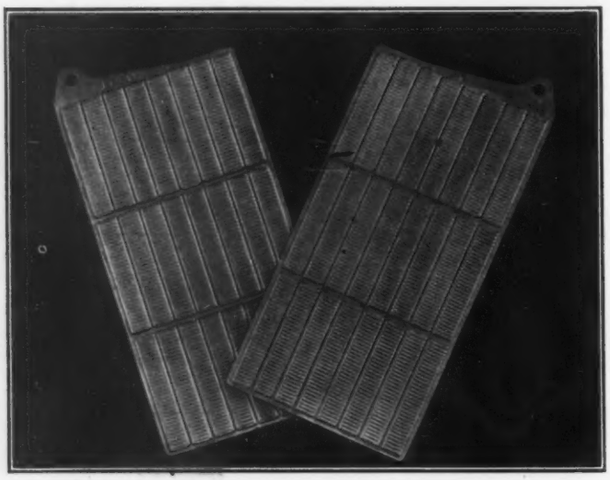


Fig. 5—Negative, or Iron, Plate.

with no compromise. Accordingly, the "E" cell was discontinued; and a mighty siege on Nature was begun, which culminated eventually in a surrender of secrets such as to insure to the Edison battery a permanent place in the Hall of Great Inventions. The "A"-type cell is the embodiment of these discoveries. Let us, then, look into this "A"-type cell.

It will be seen at once that the construction of the two kinds of plate is radically different. The negative, or iron plate (Fig. 5), has the familiar flat-pocket construction. Each negative contains 24 pockets, a pocket being ½ in. wide by 3 in. long, and having a maximum thickness of a little more than ⅛ in. The positive, or nickel, plate (Fig. 6) is seen to consist of two rows of round rods, or pencils, 30 in number, held in a vertical position by a steel support frame. The pencils have flat flanges at the ends (formed by closing in the metal case), by which they are supported and electrical connection is made. The frame is slit at the inner horizontal edges, and then folded in such a way as to make individual clamping jaws for each end flange. The clamping-in is done at great pressure and the resultant plate has great rigidity and strength.

The perforated tubes into which the nickel active material is loaded are made of nickel-plated steel of high quality. They are put together with a double-lapped spiral seam to give expansion-resisting qualities, and as an additional precaution small metal rings are slipped on the outside. Each tube is ¼ in. in diameter by 4⅛ in. long and has eight of the reinforcing rings.

It will be seen that the "A" positive plate has been given the theoretically-best design to prevent expansion and overcome trouble from that cause. Actual tests, long-continued under very severe conditions, have shown that the construction is right and fulfills the most sanguine expectations.

The other "bug" in the old construction—the use of graphite—was not so easy to eliminate. The inventor realized that a metal insoluble in the electrolyte and able to withstand electrolytic oxidation was the logical thing, and, naturally, he thought of nickel at once; so nickel and other metals were tried in various forms and under different conditions of mixture with the nickel hydrate. The results at first obtained might have been considered good had the inventor not previously developed the efficiency of graphite so far and known what high specific capacity could be realized in nickel hydrate. As it was, the results were considered unsuccessful.

Nothing daunted, Edison still kept his faith in nickel, believing that *the material* was not at fault, but only its form and the method of using it. So with redoubled energy the experimentation was continued until, after a lavish expenditure of time, labor and money, success was attained, and this in a degree proportional to the difficulties encountered.

Nickel was found to give highly satisfactory results if made into thin flakes of a certain quality and loaded into the tubes in layers interspersing with layers of nickel hydrate.

"How simple!" one will say. "Why should that problem have been so difficult of solution?"

Details! is the answer; it is the little things that are really big. And here it is worthy of note that attention to details in the application of a principle is all that makes for one man a brilliant success where through neglect of them another fails.

The practical success of nickel flake in the Edison battery was only assured when it was found how to make it, on a commercial scale, so that each individual flake would have certain physical and chemical characteristics in conformity to standards found good by experiment. And then the battle was only half over, for the manner of loading the materials into the tube makes a great difference in the result; so the best process had to be determined and machines invented to carry out that process commercially and yet with precision.

An idea of the conditions inside a loaded tube can best be had by microscopic examination. Fig. 7 shows a magnified section of a regularly loaded tube which has been sawed lengthwise. The vertical bounding walls are edges of the perforated-metal containing tube; the dark horizontal lines are layers of nickel flake, while the light-colored thicker layers represent the nickel hydrate. It should be noted that the layers of flake nickel extend, practically unbroken, across the tube and make contact with the metal wall at both sides. These metal layers conduct current to or from the active nickel hydrate in all parts of the tube very efficiently. There are about 350 layers of each kind of material in a 4⅛-in. tube, each layer of nickel hydrate being about 0.01 in. thick; so it will be seen that the current does not have to penetrate very far into the nickel hydrate, one-half a layer's thickness being the maximum distance. The perforations of the containing tube, through which

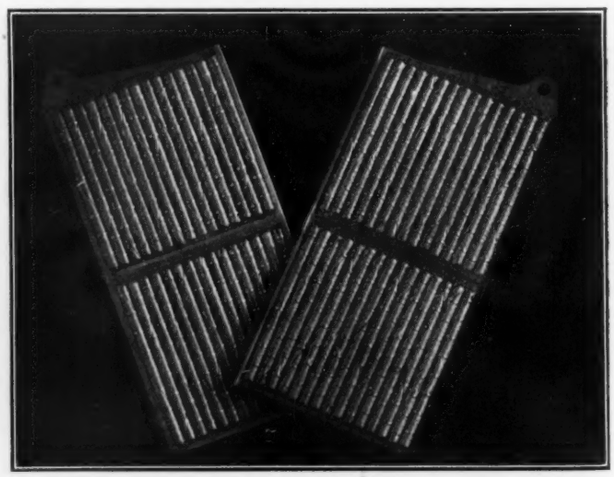


Fig. 6—Positive, or Nickel, Plate.

the electrolyte reaches the active material, are also shown in Fig. 7.

From the foregoing it will be understood that the troublesome member of the Edison battery has always been the nickel. The iron active material and the design of the iron electrode were developed to a high degree of perfection some years ago, and have since remained unchanged, except that improvements have been made in the manufacturing processes.

In summation, then, the characteristics of the Edison battery which fit it so pre-eminently for transportation service, are as follows:

1. The perforated-container construction prevents loss of material by disintegration, doing away with sediment short-circuits and the necessity of cell washing.

2. A steel containing can has very obvious mechanical advantages over a hard-rubber jar, and the expensive delays and trouble caused by jar breakage in lead batteries are thus eliminated.

3. The steel-and-copper connectors used in connecting cell posts are easily removable, and make it possible to disconnect

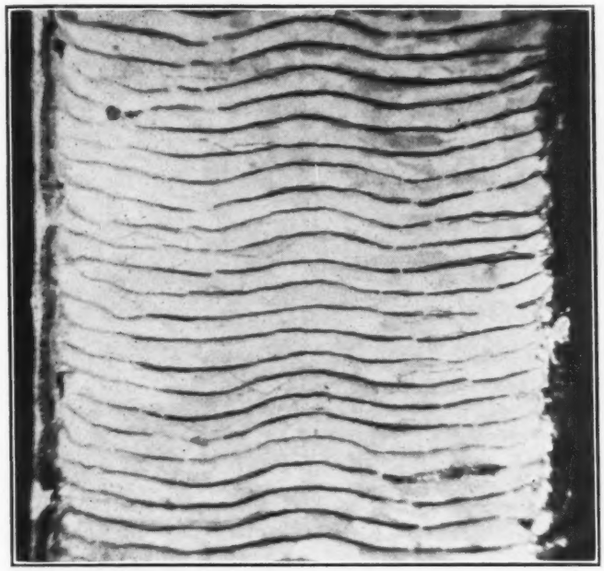


Fig. 7—Sectional View of a Loaded Tube. Magnified About 12 Diameters.

or replace any cell of a battery in a very short time without the employment of skilled labor, such as a "lead-burner."

4. The steel-and-nickel construction of the plates makes "buckling" impossible; even a dead short-circuit of the poles will not affect the condition of the plates in the slightest.

5. The simplicity of the care required enables one garage man to look after a large number of batteries, or makes it possible in private service for anyone to care for and operate his own pleasure vehicle with little trouble and most satisfactory results.

6. The materials used in the cell being exceedingly durable by nature and the construction being very rugged, a cell will stand an almost unlimited amount of vibration and shock without injury.

7. Freedom from "sulphation" or any kind of chemical corrosion eliminates a very insidious source of trouble and depreciation.

8. Lack of corrosive fumes prevents destruction of the metal work of vehicles and of the garage equipment.

9. The light weight of the battery in comparison with lead batteries gives it many evident advantages. The wear on tires is reduced; the vehicle can be built lighter; the cost of battery and of charging current required for moving unprofitable load, i.e., the weight of battery and vehicle, is much reduced, or, in other words, a much larger percentage of the total weight transported will be *paying load*. This characteristic of lightness also makes possible the building of machines of exceedingly high mileage capacity.

10. The crowning feature of the Edison battery, however, is its *great durability*. This renders it a dependable piece of apparatus and not a makeshift which has to be humored, coaxed and doctored. It is safe to say that this feature alone would have insured the battery's success without the many attendant advantages which it possesses.

11. The so-called efficiency of the Edison battery is low, being normally about 60 per cent, where a lead battery, if new and in good condition, would give 75 per cent to 80 per cent. By this is meant that of the energy actually used in charging only about 60 per cent will be recovered on the discharge. If charging current were the principal item of expense in vehicle operation this fact might be serious, but it is universally recognized that cost of charging current is an insignificant item and of no practical account in comparison with the other factors of care and maintenance. Moreover, as is well known, a lead battery does not long remain "new and in good condition," and its high first efficiency accordingly is not maintained. The true measure of a battery's efficiency is the ratio of the total cost of operation over a long period of time to the load carried and the distance traveled, due allowance being made for reliability. Expressed in a formula:

$$\text{Practical efficiency} = \frac{\text{Total cost of maintenance and operation}}{\text{Paying load} \times \text{miles carried} \times \text{reliability factor}}$$

the "reliability factor" being percentage of working time that the machine is in commission. In the light of this practical formula it can truly be said that the efficiency of the Edison battery is *high*—much higher than that of any other.

In conclusion, the writer would say that the points here presented are not speculations or mere assertions, but are proven facts, the results of innumerable laboratory and road tests which have come under his direction or observation. At some future time he hopes to describe the tests and to present actual results thereof in figures and curves.

Edison Laboratory.

CABLE POT-HEADS.

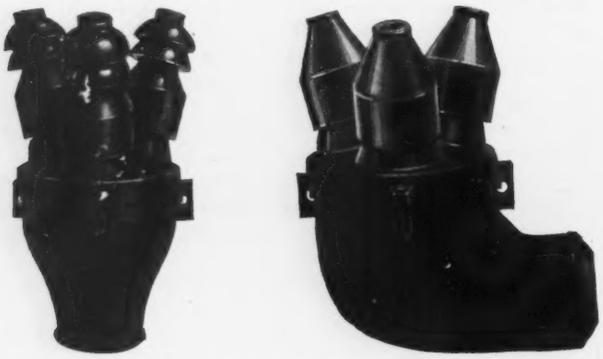
The art of installing lead-covered cables has been vastly improved within the last five years by the introduction of facilities for properly terminating such cables in the form of pot-heads. The necessity for a pot-head suited to out-of-door conditions, and which will permit the circuit to be easily opened at the cable end, led the engineers of the G. & W. Electric Specialty Company, Chicago, to develop the line of detachable porcelain pot-heads, the first types of which were brought out about six years ago. The use of a porcelain sleeve with an insulator type of cap solved the problem of exposure to the weather, while a combination of suitable current-carrying parts contained within

Figs. 1 and 2—Cable Pot-Heads.

the porcelain produced a device which is detachable—that is, without tools of any kind an operating man may disconnect the circuit by the simple act of lifting the cap from the tube. When the circuit is to be closed the cap is replaced and the connection is simultaneously made. Thus the cost is saved of cut-out boxes on outside lines and knife switches on inside work as disconnectives. Pot-heads of this type have been developed for single and multiple-conductor cables up to 10-conductor cables,

detachable or non-detachable, combination pot-heads and series and subway cut-outs for circuits up to 33,000 volts.

The most recent addition to this line is a form of multiple-conductor pot-head designed for voltages up to about 7500 for



Figs. 3 and 4—Cable Pot-Heads.

outside use and 15,000 for inside use. The new form is not so large as the older type and will be found better suited to station or line conditions where space is limited, as the bowl is but 6 in. in diameter. The general appearance is shown in Fig. 1, which shows one line disconnected, the cap having been removed. It is reconnected by merely replacing the cap. Another new feature is shown in Fig. 2, and consists of an adapter by which the pot-head may be set upon the top of an iron pipe of any size from 1½ in. to 3 in. inside diameter. The form for use indoors is shown in Fig. 3. This is equipped with connectors for use with conductors up to 2-0 to 300,000 circ. mil. This form is also made for side entrance of the cable, either right or left hand, the right-hand type being shown in Fig. 4, where it is equipped with plain caps.

USES OF PRIVATE LINE TELEPHONES IN A MODERN THEATER.

The New Theater, which was opened early this season in New York City and has for its purpose the fostering of dramatic

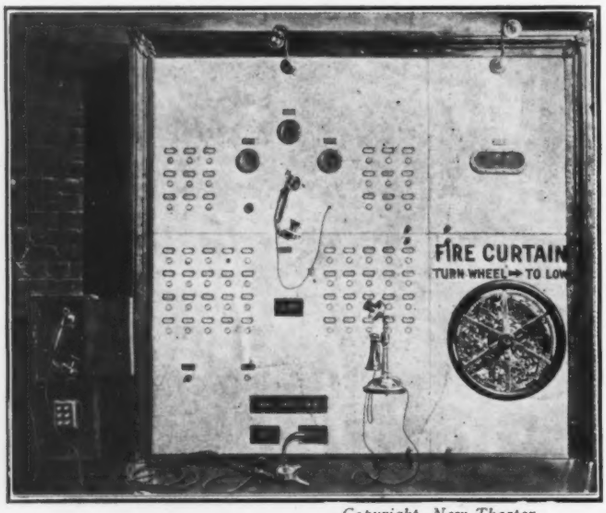


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Fig. 1—Technical Director's Board.

art, stands apart from modern playhouses as representing the highest achievement in electrical art as applied to the stage. The lighting equipment is the latest development of the automatic type. The revolving stage, electrically operated, makes possible the setting of several scenes at one time. The stage managing and directing are systematized, and everything takes place about the stage exactly as it was planned with a smoothness that is comparable only to the precision of clockwork. Every operation in the production of a play is carefully worked out and executed by a definite plan, so that when the curtain

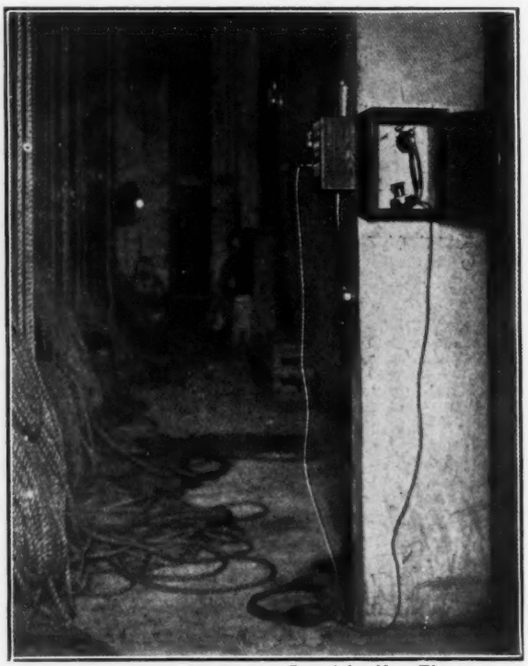

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Fig. 2—Telephone Set at Working Gallery.

rises everything is as it should be, minus the confusion which accompanies staging in most playhouses.

In the execution of orders at and about the stage, and in the arrangements for the convenience of patrons, the telephone plays an important part. The illustrations herewith show the working of two separate telephone systems—the stage or technical director's system and the carriage-call system. Each of these systems is especially adapted for the particular service which it performs, and was designed, manufactured and installed by the Western Electric Company.

The stage telephone system is an intercommunicating system, comprising nine regular stations about the stage, 25 floor stations and two master stations, or stations from which all the other stations may be reached by signals and brought into communication. One of these stations is known as the stage manager's board; the other (Fig. 1), the technical director's board and the one most used in directing the operations on and about the stage. The nine regular stations comprise six stations located in the flies and stage galleries and the stations at the electrician's booth, prompter's booth and for the orchestra leader. The six stations located in the flies and galleries are intercommunicating, while the other three are used by the stage manager or technical director to give the cues signaled from these respective stations.

The six stations located in the flies and galleries are distributed at important points from the cellar to the eleventh floor. Each is equipped, as shown in Fig. 2, with a portable hand telephone set. This station is known as the working gallery, and communication can be obtained between it and the five other stations located as follows: Shot chamber in the cellar, stage floor at controller for revolving stage, working gallery, first fly gallery, second fly gallery and rigging loft at the eleventh floor. These stations are signaled by means of buzzers operated by push-buttons, shown at the left of the telephone in Fig. 2.

Besides these nine regular stations, there are distributed throughout the stage, flies and galleries 25 flush telephone outlets in the floor, known as the floor stations, each outlet being suitable for receiving a short telephone plug. Each of these

stations is provided with a lamp signal, 2 in. in diameter, to indicate the incoming calls. The scene shifters and other stage operators are provided with a head receiver and chest transmitter attached to a cord which terminates in a plug, which set

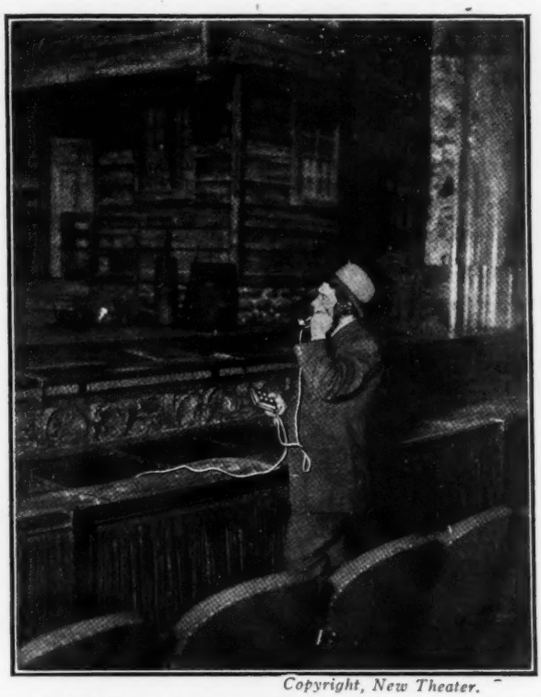

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Fig. 3—Telephone Used for Directing Trimming of Stage Hangings.

is shown in Fig. 1. The signals for calling these stage hands are operated by means of push buttons from either the technical director's or stage manager's board. The system is so arranged that when either stage manager or technical director wishes to communicate with any of the stage operators he presses the proper button of the series shown at the right and left in Fig. 1. Those at the right operate the bull's-eye flash signal at the floor stations, while those at the left operate buzzers at the regular wall stations. The arrangement of the bull's-eye lamp signal in the flies and galleries is such that in case it is too noisy about the stage to attract the operator's attention at the regular station by the buzzer located there, the signal can be given him by means of the bull's-eye flash signal.

In conjunction with the telephone equipment arranged as mentioned, a system of call bells is provided to signal stage hands when not on the stage. The nine buttons on each side of the technical director's board at the top are used for this purpose and are connected to buzzers located at various rooms where stage help can be found in case of emergency or at other times when they are not on the stage and their services are desired.

The floor stations and flash signal are intended principally for the heads of those departments which have to do with the stage help and scene shifters. The heads of each department with whom it is necessary to communicate wear a head receiver and chest transmitter all the time, so that whenever they notice their particular flash signal they know they are wanted and go to the nearest receptacle to learn what is desired. In case the particular head is not near the signal and does not see it, the information is transmitted to him through the station on the particular fly or side of the stage where is is supposed to be stationed. During the performance of any scene, instructions can be given by this method without annoyance or any disturbance whatever. Also any instructions or additional orders can be given for any future changes to be made during the acting of any one scene. This system is a great convenience to the stage manager and technical director in that it saves many steps and makes it unnecessary to shout from one side of the theater to the other.

Another feature of this telephone system is its use in trimming the ceilings, stage borders and hangers. The technical director does the final trimming for any scene from the first row of the orchestra, as shown in Fig. 3. It will be noticed that the telephone set used in this case is a portable hand set, the same as in Fig. 2, and is an extension to the corresponding telephone set at the technical director's board. The set is connected to this board by means of a flexible cord, which is about 30 ft., or long enough to reach to the first row of the orchestra. By means of a portable set of buttons, which the technical director holds in his hands, he is able to signal the six important stations in the flies and galleries mentioned above. With communication between these stations he is able to make any changes which he finds necessary by viewing the setting from the body of the house.

The second telephone system mentioned is the one connected with the carriage-call system. As shown in Fig. 4, the attendant located at the window of the lobby is equipped with a head receiver and chest transmitter which is attached to a line terminating in a plug receptacle in the sidewalk on the outside of the building near the entrance. At this station another attendant is stationed at the end of the performance provided with a hand telephone set plugged into the receptacle, thus connecting him with the attendant in the lobby. As the patrons of the theater come out of the house into the lobby they step to the window and announce the number of their carriage or automobile. This number is flashed on two electric signs, one at the top of the theater at the front and the other on the side. When the driver recognizes his number and appears in the line so that the attendant on the sidewalk can see him, this attendant then transmits the number through his telephone to the attendant at the window, who in turn announces it to the patron. This system works out very satisfactorily, and is one which gives ready information to the patron who is waiting, without making it necessary for him to leave the lobby.

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Fig. 4—Telephone Set Used With Carriage Call System.

In addition to these private-line telephones the theater has installed a standard Western Electric private-branch exchange switchboard with approximately 36 house extensions to the various places about the stage, box office entrances and executive offices arranged with six trunk lines connected to the city exchange.

Industrial and Commercial News

The Week in Trade.

UNSETTLED conditions in commodity prices and the destructive effect of the violent storm which visited the Central West dealt serious blows to retail business last week. Winter wheat is badly injured, the cotton crop is seriously damaged and fruits in certain sections are almost destroyed. The full extent of the damage is not yet known, but retail business has been demoralized. The disturbance in the cotton market has injuriously affected the entire textile trade, and the financial difficulties of one of the largest jobbing houses in the United States on account of the unsettled cotton prices has alarmed, to some extent, all branches of trade which are interested in textiles. While it is generally admitted that this firm is perfectly solvent, the fact that prices of raw cotton, and therefore necessarily of all cotton goods, have been unsettled for so long has put the firm in a position where it cannot immediately realize upon its stock. The average prices for food and other necessaries of life continue to decline, and this is taken as an encouraging indication. Lower prices for commodities will not only stimulate the export trade, but will do much to pacify the widespread unrest among wage-earners. In the industrial world there continues to be plenty of activity, although it is reported that even in the iron and steel trade the rush of orders is in a measure slackened. Railways continued to be heavy purchasers of equipment during the past week, and orders for more than 30,000 tons of steel rails were placed. Collections continue to be only fair. Business failures for the week ended April 21, as reported by Bradstreet, were 193 as against 207 the previous week, 247 in 1909, 254 in 1908, 157 in 1907 and 177 in 1906.

The Copper Market.

FURTHER declines and general weakness were the principal features of the copper market last week. In spite of the fact that it is now admitted that the actual consumption of copper is greater at the present moment than it has been at any time since the beginning of the period of depression, the market is unsettled and prices are sagging. During the week the actual sales were very light, although consumers were evidently keeping in close touch and appeared to be ready to pick up any bargains that are offered. It is evident that buyers are growing canny and are no longer frightened into making purchases by advancing prices as appeared to be the case six months ago. The most significant feature of the week was the drop of £1 in the asking price of the Amalgamated company in the London market. This indicates a pressure to sell that has not been allowed to appear for a number of months. Even with this marked reduction nearly all the foreign business of the week was taken by the independent interests. The continued liquidation of American speculators in the London market added to the unsettled condition, and, taken altogether, the whole week was extremely unsatisfactory. Imports continued to be very liberal, and the production at the domestic mines goes on at a record-breaking pace. There is no doubt about the market being heavily overstocked and the weekly circular of the National Conduit & Cable Company called especial attention to this fact in its last week's circular. On this point it said: "Latest advices from the mines show heavy outputs, with no plans for curtailment. Low prices and the unsettled condition of the market cut down cash prices for the operating companies, but there is nothing to reassure manufacturers that the bottom has been reached. Ore shipments to smelters recently have been enormous, and there is no reason to expect much change in the immediate future, unless it is a further increase in the ore output. The prevailing basis of costs makes possible sufficient earnings on the present copper market for the greater part of current production. Therefore, with copper selling at anything over 12 cents, there will be a forcible inducement to produce it in large quantities." Exports for the month, including April 25, have been 10,134 tons. On the Metal Exchange, April 25, standard copper was quoted as per accompanying table:

	Bid.	Asked.	Settling price.
Spot	12.40	12.55	.....
April	12.50	12.55	12.52½
May	12.50	12.52½	12.52½
June	12.50	12.55	12.52½
July	12.50	12.60	12.55

The London market closed April 25 as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	56	12	6	56	7	6
Standard copper, futures	57	12	6	57	10	0

Extreme fluctuations this year:

	Highest.			Lowest.		
Standard	13.50c			12.45c		
London, spot	£62	0	0	£56	10	0
London, futures	62	18	9	57	10	0
London, best selected	65	10	0	60	15	0

Commercial and Industrial Notes.

U. S. Heat & Lighting Company's New Plant.—The United States Heat & Lighting Company, organized January, 1909, with a capital stock of $17,500,000, broke ground in Niagara Falls, N. Y., April 22, for a new plant to consist of 16 buildings which will cover about 10 acres of a 20-acre plant site. When the new Niagara plant starts it will employ about 1500 hands and use 1000 hp, which power will be obtained from the Niagara Falls Hydraulic Power & Manufacturing Company. The site is at the north end of the city adjacent to the plant of the Carter-Crume Company, in the section promoted by the Niagara Falls Hydraulic Power & Manufacturing Company, which company was largely instrumental in effecting the location of the plant in Niagara Falls. The contract for the buildings is in the hands of Snyder & Gillette, of Niagara Falls; the sprinkler system will be installed by the American Sprinkler Company, of New York, and the heating system by the Harrison Engineering Company, of New York. Concrete, brick and timber are the materials to be used in construction. Two of the buildings will be 246 ft. x 40 ft., two stories; two 280 ft. x 50 ft., three stories; one 160 ft. x 50 ft., two stories; one 144 ft. x 50 ft., one story; one 120 ft. x 50 ft., one story; one 112 ft. x 52 ft., one story; one 136 ft. x 40 ft., one story; one 298 ft. x 50 ft., one story; three 176 ft. x 60 ft., one story, and one 75 ft. x 18 ft., one story. It is expected that the first completed buildings will be ready for occupancy by early fall. The United States Heat & Lighting Company is a consolidation of the National Battery Company, of Buffalo; the Bliss Car Lighting Company, of Milwaukee, and the United States Light & Heating Company, of New Jersey. All of the company's interests will be merged in Niagara Falls. The company manufactures various sizes of axle-driven generators for mounting under railroad cars to be driven by belt and axle pulleys, the current being used for light, heat and ventilation purposes in railroad cars of various classes. It builds all necessary controlling devices as well.

Recent Sales of Crocker-Wheeler Company.—Among the principal sales recently made by the Crocker-Wheeler Company are: One 300-kw, one 150-kw and one 400-kw engine type direct-current generators, to Bridgeport (Conn.) Malleable Iron Company; one 100-kva alternating-current generator with direct-current exciter, to Carl Stahn, Massachusetts; two 500-kw synchronous motor generator-sets and small motors aggregating 3150 hp, to Illinois Steel Company; one 250-kw engine type generator, Cribben & Sexton Company, Illinois; one 100-kw generator, to Canton (Ohio) Engineering & Electric Company; one 400-kw generator, to Roxford Knitting Company, Pennsylvania; one 250-kw direct-current generator, one 400-kw engine type generator, to Egyptian Powder Company, Illinos; six induction motors, aggregating 85 hp, and three 100-kva transformers, to Norton Grinding Company, Massachusetts; one 150-kw generator to Belmont Iron Works, Pennsylvania; one 100-kw generator, through Canadian branch, to Nova Scotia Steel & Coal Company.

Allis-Chalmers Gas Engines.—The American Steel & Wire Company has recently purchased from the Allis-Chalmers Company two gas engines for its central furnace plant at Cleveland, O. These engines have a maximum capacity of 5000 hp each, and are the largest gas engines ever built in this country. This makes a total of 50 Allis-Chalmers gas engines which have been sold to the United States Steel Corporation.

"Don'ts" for American Exporters.—A writer in the *Bulletin* of the Berlin, Germany, American Association of Commerce and Trade gives the following advice to American exporters to Germany: Don't sell your goods by catalog. Don't disregard recommendations of your agent or representative, who, generally, knows the market better than you do in your home office. Don't try to force goods on the Germans, when your agent tells you such goods have no demand. Don't fail to back up your agent by judicious advertising, as real American style of advertising always attracts the eye and always pays for itself. Don't give your agency to a German merchant, forget all about him for a year or two and then wonder why he is doing nothing for you. Don't forget to supply your agent with a good stock of samples, as samples well displayed in show windows sell goods. Don't fail yourself to visit Germany occasionally and convince yourself that your goods are properly displayed. Don't fail to put confidence in your agent and give him credit for knowing more about the foreign market than you do. Be satisfied with results; they tell the story! Don't fail to fill your orders promptly. Don't go into the foreign market unless you can fill orders within a reasonable length of time. Don't dump!

Big Business in Telegraph Letters.—Both the Western Union and Postal Telegraph companies declare that the business in the night letters, or "lettergrams," has been so enormous that the facilities of the companies are strained to the utmost, and the scarcity of operators is seriously felt. Belvidere Brooks, general manager of the Western Union, says that the night letters have increased rather than diminished the number of full-rate messages sent. A man receives a night letter, and because it comes by wire considers it of sufficient importance to answer by wire at once at day rates. He says that no part of the country is particularly prominent in taking up the new system, all parts using the night letters with great freedom. In speaking of the emergencies caused by the popularity of the service he referred to these instances: A short time ago a man at Winston-Salem, N. C., dropped 500 night letters into the Western Union box one evening; one Chicago house sent 1,109 letters at one time, and two New York business houses sent 8,600 letters between them in one week.

Lord Manufacturing Company.—The Lord Manufacturing Company has been incorporated to carry on the manufacturing business of the Lord Electric Company, New York, dating from April 1. The new company has a capital of $100,000, with the following officers: F. W. Lord, president; W. R. Garton, vice-president and general manager; G. Lehmann, secretary and treasurer; John D. Clay, superintendent, and F. W. Erickson complete the board of directors. The separation of the manufacturing from the sales and contracting business, which is continued by the Lord Electric Company, was deemed advisable, owing to the many additions that have been made to the line of products and the increasing volume of manufactured output. The Lord companies report present orders and contracts for their lines of protective and economizing devices aggregating over $1,250,000.

Electrical Credit Associations.—Following authorization at the annual meeting in December, the National Electrical Trades Association has just changed its name to the National Electrical Credit Association, which was deemed a more suitable appellation, distinguishing the association as it does from workmen's trade organizations, etc. In harmony with this action, all the local associations are changing their names as follows: New England Electrical Credit Association, New York Electrical Credit Association, Philadelphia Electrical Credit Association, Chicago Electrical Credit Association, Pacific Coast Electrical Credit Association. Under the New York State law the change in the name of the New York body will be effected by resolution of the Board of Directors at the next meeting, to be held May 12.

Postal Telegraph and Telephone Alliance.—The Postal Telegraph Company has formed an alliance with the Frontier Telephone Company, of Buffalo, for the mutual promotion of business in New York State. The deal is similar to that now operating between the American Telephone & Telegraph Company and the Western Union Telegraph Company. The telephone company will receive and deliver messages for the telegraph company, and the arrangement is expected to add to the business of both corporations. The Frontier Telephone Company reaches about 1200 points in New York State which the Postal Telegraph Company does not cover. Under the new arrangement the Postal will be able to use the Frontier wires to cover these points.

Special Appeal for Employment.—A letter received from an inmate of the State Reformatory makes an appeal for employment as electrician and engineer of an isolated lighting plant, or other work where experience as a stationary engineer (two years) and electrician (four years) would be qualifications. The young man is 19 years old, and will be released from confinement if he can obtain employment satisfactory to the reformatory authorities. The appeal has the approval of these authorities, and the consent of the chief engineer for the use of his name as a reference. We shall be glad to forward to the reformatory any inquiries concerning the young man made with a view to his employment.

Stone & Webster at St. Louis N. E. L. A. Convention.—The unusual interest being taken in the coming National Electric Light Association convention at St. Louis, May 23 to 28, is indicated by the engagement by the Stone & Webster syndicate, Boston, of 45 rooms at the Hotel Jefferson for convention week. The company will hold its own convention either before or after the National Association sessions. The New England delegation of the syndicate has engaged a special car, which will go from Boston to St. Louis in charge of Mr. William H. Blood, Jr.

Proposed Power House for New York Capitol.—By a law passed at the recent session of the New York Legislature and approved by the Governor, the trustees of public buildings are empowered to select a suitable site for a power house from which heat, light and power shall be furnished the State Capitol and the State Educational Building at Albany. The State architect is to plan and supervise the erection of the proposed building, which, with its contents, will cost not to exceed $500,000.

Contracts for 1500-hp Central Station.—Mr. Henry Floy, 165 Broadway, New York, consulting engineer for the Middletown Electric Light Company, is receiving bids and awarding contracts in accordance with his plans and specifications for a new and modern 1500-hp central station to be erected this summer at Middletown, Conn. The power house is to be of fireproof construction, built on concrete piles and designed for an ultimate capacity of 3000 hp.

New Plant of Triumph Electric Company.—The new plant at Oakly of the Triumph Electric Company and Triumph Ice Machine Company, Cincinnati, Ohio., will be inspected April 30 by delegations from the Business Men's Club, Chamber of Commerce, Manufacturers' Club, Cincinnati Industrial Bureau and Cincinnati Metal Trades Association. A special train will take the party to the works, where a luncheon will be served.

Crown Electrical Company.—The Crown Electrical Company, of St. Charles, Ill., has perfected plans for locating a Canadian branch at Brantford, Ont. The Canadian factory will employ 75 hands, and work upon the building will be commenced immediately. One half of the $10,000 capital of the Canadian branch was subscribed by citizens of Brantford.

One Hundred Studebaker Electric Vehicles for Department Store.—The Studebaker Company has closed a contract for 100 electric vehicles, to be used by Gimbel Bros., for the delivery service of its New York department store, now nearing completion. The order includes 40 1000-lb. and 30 2000-lb. vehicles and a half dozen 7000-lb. freight trucks.

Kyoto, Japan, Municipal Plant Equipment.—The order for the water turbines of the Kyoto, Japan, municipal plant has been placed with the Escher-Wyss Company, Zurich, Switzerland. The order for the five 1500-kw generating units was placed with the General Electric Company, as stated in our issue of March 3.

The Elmer P. Morris Company, New York, is erecting a large factory at Elizabethtown, Pa., for the manufacture of lamp posts and lighting specialties for exterior work. Upon its completion the present factory at Newark, N. J., is to be closed down, the new works having a capacity several times greater.

New Line of Foreign Material.—E. J. Kulas, of the Tungstolier Company, Cleveland, will, this week, return from a trip abroad, during which he completed arrangements for introducing in this country a new line of material concerning which details will be announced later.

Use of Telephone in Railway Service.—The Norfolk & Southern Railway Company is about to install a telephone train dispatching system on its main line from Norfolk, Va., to Washington. The line over which this dispatching will be done consists of two heavy copper wires, each weighing 210 lb. to the mile, so that an accuracy of transmission will be obtained equal to any furnished by commercial telephone lines. The equipment, which has been ordered from the Western Electric Company, is the Western Electric-Gill system. Twenty stations along the 136 miles of line will be equipped so that the dispatcher can call them individually or collectively. In addition the railroad will install about eight siding telephone sets along the line, where the train crew can be put in immediate connection with the dispatcher's office. There will also be put in use portable telephone sets for use on trains, where, by means of a jointed pole connection the train crew can reach the dispatcher's office in cases of emergency. The Virginian Railway, in the same territory, has recently placed an order with the Western Electric Company for train-dispatching equipment to extend over its first and second divisions. When this is installed the entire railroad will be equipped with telephone apparatus. This system also uses the Gill selectors. The two divisions above referred to extend from Norfolk to Roanoke, Va., and are about 250 miles in length. The transmission will be upon copper wire, 210 lb. to the mile, and there will be 31 stations equipped with selectors and 27 with telephones, but not selectors along the route. The Northwest, too, is taking up the use of telephones. The Great Northern Railway, which at the present time is using telephone service to dispatch trains on divisions covering approximately 2100 miles, has recently placed orders with the Western Electric Company for apparatus to cover six more divisions, approximately 1900 miles. The apparatus used on the Great Northern is the Cummings-Wray selector, this style of equipment having been adopted as standard by this railroad company; 290 stations will be completely equipped for this new service. One feature of this installation is that telephones will be placed at sidings which are not open during the whole of the 24 hours, so that train crews can reach the dispatcher at any time. When these installations are made the Great Northern Railway will be using telephone service over the entire main line from Minnesota to the Pacific Coast.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants and considerable extensions of present plants at Hermiston, Ore.; Denver, Col.; Jamestown, Kan.; Cherokee, Okla.; Indianapolis, Ind.; Carthage, Ind.; Middletown, Conn.; Fargo, N. D.; Amity, Ore.; New Martinsville, W. Va.; Stockton, Cal.; Las Vegas, N. M.; Decatur, Ill.; Manti, Utah; Idaho Falls, Idaho; Evansville, Ind.; Fort Missoula, Mont.; Fort Morgan, Ala.; Mosinee, Wis.; Waterloo, Ia.; Bedford, Ind.; St. Louis, Mo.; Winston-Salem, N. C.; Boley, Okla.; Seneca, S. C.; Shelbyville, Tenn.; Thorndale, Tex.; Trinity Center, Cal.; Paradise, Cal.; Truckee, Cal.; Mt. Vernon, Ohio; Easley, S. C.; Eureka City, Cal.; Bedford City, Va.; San Bernardino, Cal.; Spring Valley, Minn.; Providence, R. I.; El Centro, Cal., and South Bend, Ind.

White Water Land & Power Company.—The White Water Land & Power Company, of San Bernardino, Cal., which has taken over the water rights located on the Mojave River secured by Arthur E. Poole, has transferred the property to the Consolidated Reservoir & Power Company. The plans of the development are to establish a large irrigation system by impounding the water at Victor Narrows. The work includes dams, bridges, etc. The new company has also secured the interests of the E. E. Hendrick estate in the river, and a portion of the rights of the Palm Valley Water Company.

Arkansas Hydroelectric Development.—The Garland Power Development Company, of Little Rock, Ark., has been granted a charter by the State Board of Railroad Incorporation to construct a dam across the Ouachita River, near Ross Ford, in Montgomery County, and to construct a power plant at that point. The State reserves the right to fix, at any time, the charges for the transmission of energy.

Standard Electric Time Company.—Announcement has been made by the officials of the Standard Electric Time Company, of Waterbury, Conn., that the plant and mechanical force of that company will shortly be removed to Foxboro, Mass., where an adequate floor space has been secured at the plant of the Standard Gage Company. The Standard Time Company was incorporated in 1898 with a capital of $10,000.

Financial.

The Week in Wall Street.

AFTER a week of ragged and unsettled prices the Wall Street market on April 25, the last day under review, sold off sharply and the lowest prices since the decline of February were recorded. There was not, however, any great selling pressure and the weakness of the day, like the weakness of the entire week, was mainly because no one took any interest in the market outside of a few professionals. One staggering blow to trading enthusiasm were the heavy engagements of gold for shipment. During the day contracts were made for $11,000,000. Up to the end of last week the shipments had been $17,500,000, so that already there has been engaged somewhat more than $25,000,000, which was originally estimated to be the limit of the movement. Even with this heavy drain the money market has not become stringent to

NEW YORK.

	Apr. 18.	Apr. 25.	Shares sold.		Apr. 18.	Apr. 25.	Shares sold.
All.-Ch.	11	10½*	360	Int.-Met., pfd.	59⅛	56¾	65,025
All.-Ch., pfd.	39	36½	700	Mackay Cos.	89½*	89½	—
Amal. Cop.	76⅜	72⅛	178,600	Mackay C., p.	77⅞*	77¼*	100
Am. D. T.	20½*	20½*	—	Man. Elev.	136½	137*	75
Am. Loc.	52	49⅛	2,800	Met. St. Ry.	15*	15*	—
Am. Loc., pfd.	113	113*	102	N.Y.&N.J.Tel.	139¼*	139¼*	—
Am. Tel. & C.	75*	75*	—	Steel, com.	86¼	81⅝	979,100
Am. T. & T.	138	135½	5,384	Steel, pfd.	121¾	119¾	5,903
B. R. T.	81	77¼	69,765	W. U. T.	72	70	1,189
Gen. Elec.	152	149¼	1,700	West'h., com.	67⅝	62	5,160
Int.-Met., com.	22⅞	22	50,050	West'h., pfd.	125*	125*	—

PHILADELPHIA.

	Apr. 18.	Apr. 25.		Apr. 18.	Apr. 25.
Am. Rys.	45	45	Phila. Elec.	15⅝	15⅛
Elec. Co. of A.	11⅞	12*	Phila. R. T.	20¼	19¼
Elec. St. B'ty	61½	60¾	Phila. Trac.	86½*	86½
E. S. B'ty, pfd.	38*	30*	Union Trac.	48⅞	48¼

CHICAGO.

	Apr. 18.	Apr. 25.		Apr. 18.	Apr. 25.
Chi. City Ry.	180	180*	Chi. Tel. Co.	129	120
Chi. Rs., Ser. 1	97	99*	Met. El., com.	16	17
Chi. Rs., Rer. 2	29	29	Met. El., pfd.	53	56
Com. Edison.	116*	114	Nat'l Carbon.	112¾	111½
Chi. Subways	2¼	2½	Nat'l Car., pfd.	119	119*

BOSTON.

	Apr. 18.	Apr. 25.		Apr. 18.	Apr. 25.
Am. T. & T.	138	135¾	Mex. Tel.	6	6¼
Cum. Tel.	150	149	Mex. Tel., pfd.	7	7¼
Edison E., Ill.	255	250*	N. E. Tel.	135	134*
Gen. Elec.	151	150*	W. T. & T.	16	15½
Mass. E. Ry.	19*	18	W. T. & T., pfd.	90	87
Mass. E. R., pfd.	88*	86			

* Last price quoted.
Shares sold for week of April 18 to April 23.

any degree, and the banks are still liberal enough to encourage a far greater amount of trading than is actually being carried on. The heavy storm in the West has had a depressing effect, and the fact that almost every important railroad has been forced to advance wages without being able to advance rates has led to the opinion that coming reports will not record the large percentage of increases that have encouraged the market during the past six months. The political situation, too, has been somewhat disturbing, and large holders of industrial securities do not view with much enthusiasm the breaking up of the old guard in the Senate and the recent triumphs in isolated congressional districts of pronounced reactionaries. The large financial interests are apparently taking no hand in directing the market, and it is drifting upon a languid tide. Fortunately there seems to be no bear clique that has sufficient nerve to attack, and so there is little danger of demoralization. Rates for money April 25 were: Call, 2½ to 3 per cent; 90 days, 4¾ to 5 per cent. The quotations in the table are those of the close, April 25.

Financial Notes.

Chicago Subway Project.—George W. Jackson, who is interested in the project, says, regarding the application for the subway franchise to be made next month to the municipal authorities of Chicago, that the plan involves the definite expenditure of $75,000,000, covering lines in the following area: Wilson Avenue, Seventy-third Street and Forty-eighth Avenue. Down-town routes will follow street-car lines closely. The proposed subway system is thoroughly comprehensive.

New England Telephone & Telegraph Company.—A special meeting of the stockholders of the New England Telephone & Telegraph Company has been called for May 2, to vote upon the proposition to increase the number of directors and amend the by-laws of the company.

Marconi Wireless Telegraph Company.—At the annual meeting of the Marconi Wireless Telegraph Company last week, the stockholders voted to reduce the capitalization of the company from $6,500,000 to $1,625,000, to be accomplished by reducing the par value of each share from $100 to $25. In speaking of this reduction, John Bottomley, vice-president and general manager of the company, said that the reduction was made in order to reduce the taxation charges which the company had to pay in various States, where the assessment was made upon outstanding capital stock and not upon property. He said that the property of the company was just as valuable at present as it was before the reduction was made. William Marconi telegraphed the stockholders regretting that he was unable to be present at the meeting, and saying that the preliminary tests of the new station at Glace Bay had been made and that the company was now prepared to resume commercial business between this station and European points. The annual report of the company was that its business had been steadily increasing. In 1909 it sent and received 8855 more messages than during the previous year. The increase in gross receipts from its business was $25,523, and the increased cost in operation was not more than $1,000. The report also showed that the returns for February and March showed an increase of 10 per cent over the same months last year. The company now has over 300 steamship stations in operation. Mr. Marconi is confident that with the new installation of the duplex system the company will be able to handle between Glace Bay and the stations at Clifden, Ireland and Poldhu, England, at least 30,000 words per day, instead of 5000, as was formerly done.

Lewisburg (Pa.), Milton & Watsontown Railway.—The Lewisburg, Milton & Watsontown Passenger Railway Company has been purchased from the Railways Company General of New York, by Messrs. Whittaker & Diehl, of Harrisburg, Pa. A new company has been organized and the following officers and directors elected: President, John F. Whittaker; vice-president, L. G. Brown; secretary and treasurer, D. L. Diehl; assistant secretary and treasurer, W. B. Rankin; chief engineer, Charles S. Johann. The old company had an authorized capital of $300,000 bonds and $150,000 stock; $230,000 of bonds were outstanding. The new company is capitalized at $300,000 bonds and $150,000 stock. Only $150,000 bonds have been issued; the balance will remain in the treasury and will be issued for improvements and extensions at the rate of 80 per cent of the actual cost. The company has just closed a contract with the Allis-Chalmers Company for two 200-kw normal—300-kw maximum rated synchronous motor generator-sets and switchboard, the same to be installed in the new power house which is being built by the United Electric Light & Power Company, of Milton. The company proposes extending the present road several miles. C. S. Johann is in charge of all engineering work and extensions.

Washington, Baltimore and Annapolis.—Officials of the Washington, Baltimore and Annapolis Electric Line are gratified over the report of the earnings of the company for the month of March, which shows a substantial increase in the gross and net earnings of the road over the corresponding period of 1909. By saving here and there the company's officials have reduced operating expenses without impairing the efficiency of the service. The operating expenses for March this year have been $8,798 less than they were last year during the same month. Figured on a percentage basis, the company has reduced its operating expenses from 72 per cent for 1909 to about 51 per cent for the same month this year. At the present time the property is in a good physical condition, and the company's officials expect an increase in business from month to month. Earnings for April are holding up well, and the prediction is that the report for the present month will be equally as satisfactory from an earning standpoint as was the report for last month.

Third Avenue Railway Company.—A certificate of incorporation of the Third Avenue Railway Company of New York, with a capital of $16,590,000, has been filed with the Secretary of State. This company is a reorganization of the old Third Avenue Railroad Company, formed by the bondholders' protective committee which purchased the property at foreclosure sale March 1. The directors of the new company are: James N. Wallace, Adrian Iselin, Jr., Harry Bronner, James Timpson, Frederick Shipman, W. E. Roosevelt, John W. Platten, Albert W. Scholle, Joseph F. Seaman, Edward A. Mayer, Franklin L. Babcock, Milton Ferguson, George W. Davidson. It is stated unofficially that the Public Service Commission and the reorganization committee are not very far apart on the plans of reorganization, and that the matter will soon be settled and the new company placed in charge.

Chicago Railways Company.—The second annual report of the Chicago Railways Company for the fiscal year which ended Jan. 31, 1910, has just been made public. It shows gross income of $12,442,882, a gain of $1,405,811 as compared with the previous year. The net income was $3,732,864, a gain of $421,743. There was an increase, however, in the deduction made for "interest at 5 per cent on valuation," leaving the net income in which the city and company participated $1,457,146, which was $114,291 less than the net income to be divided the previous year.. The city of Chicago, which receives 55 per cent, got $801,430 for its portion of the second year's earnings, as compared with $864,290, its share of the first year's earnings. The balance sheet gives the total assets of the company as $75,058,848, as compared with total assets the year previous of $58,616,759.

Kansas City Railway Financing.—J. P. Morgan & Company and Lee, Higginson & Company have notified the holders of the consolidated mortgage 5 per cent bonds of the Metropolitan Street Railway Company of Kansas City, which mature May 1, 1910, that in order to provide for the payment of these bonds at maturity arrangements have been made for the issue under the consolidated mortgage of new coupon bonds, maturing May 1, 1913, and drawing interest at the rate of 5 per cent. The holders who wish to exchange their bonds for the new issue must deposit them ex-coupon before April 16. Bonds not so deposited will be paid in full after May 1 at the Old Colony Trust Company, Boston, Mass.

Chicago City and Connecting Railways.—It is reported that holders of Chicago City Railway stock who agreed to sell their shares as a part of the plan for the formation of the "Chicago City and Connecting Railways" have received the first instalment of the purchase price. A considerable portion of the $22,000,000 in 5 per cent bonds of the Chicago City and Connecting Railways has been disposed of, and from the proceeds there was paid $50 a share of the $100 a share due to the stockholders of the Chicago City Railway Company. In addition to $100 in cash, the stockholders are to receive 100 per cent of the amount of their holdings in "preferred participation shares" and 50 per cent in "common participation shares."

New York Street Railway Figures.—Figures for the operation of the street railway and rapid transit companies of Greater New York for the month of January have just been given out by the Public Service Commission. They show total revenues of $6,429,413 and net revenues of $2,856,504. During the month 112,817,718 passengers paid fares and 22,764,398 rode on transfers. The largest increase in business was in the subway section of the Interborough Rapid Transit Company.

Philadelphia Electric Company.—The annual report of the Philadelphia Electric Company for the year 1909 shows gross receipts of $5,489,903, and net income, after paying operating expenses, taxes, fixed charges and depreciation, of $1,202,261. This is an increase of 25 per cent over 1908. President Joseph B. McCall and his colleagues on the board of directors were re-elected by the stockholders.

North Dakota Power Plant Sold.—Announcement has been made at Fargo, N. D., that the Union Light, Heat & Power Company of that city has been sold to H. M. Byllesby & Company, of Chicago. The price paid for the property has not been made public. The company was capitalized at $700,000. Samuel Kahn will be continued as general manager of the property.

Holmesburg, Tacony & Frankford Electric Railway Company.—The United States Circuit Court of Pennsylvania has made an order fixing June 1 as the date of sale, under foreclosure, of the property of the Holmesburg, Tacony & Frankford Electric Railway Company, of Tacony, Pa. The upset price is $330,000. There are two bondholders' committees organized, both of which it is said are to bid for the property.

Calumet & Hecla's New President.—Quincy A. Shaw, second vice-president of the Calumet & Hecla Mining Company, has been elected president to succeed the late Prof. Alexander Agassiz. Mr. Shaw has been an officer in the company for many years, and is a director in many corporations, including the Old Colony Trust Company, of Boston.

Pennsylvania-Jersey Railway Company.—Plans have been completed for the merging of the Northampton Traction Company, of Easton, Pa., and the Easton & Washington Traction Company, of Washington, N. J., into one corporation to be known as the Pennsylvania-Jersey Railway Company. The first mentioned of these lines operates in the neighborhood of Easton, Pa., having 23.41 miles of track. The capital stock of this company is $500,000, and the bonds outstanding, $394,000. The Easton & Washington Traction Company operates 17 miles of road in New Jersey. It has a capital of $375,000 and outstanding bonds of the same amount. The new company will extend its lines in several directions. Work will be commenced in May upon a line from Port Murray, N. J., to Hackettstown, N. J. The next step will be a connection with Morristown, and it is stated that from there connections will be made directly with Newark and Jersey City. A line to Lake Hopatcong is also under consideration. The Northampton Traction Company's lines extend from Easton, Pa., to Nazareth and Bangor, with connections to Portland, Pa. The construction of a line from Portland to the Delaware Water Gap, four miles, is contemplated.

United Railways Investment Company.—The annual meeting of the stockholders of the United Railways Investment Company, the holding company of the San Francisco traction properties, will be held May 6. At this meeting will be submitted a resolution declaring it advisable to create a series of bonds not to exceed $6,000,000, to bear such date subsequent to May 31, 1910, as the directors may determine, drawing interest at a semi-annual rate of 3 per cent, payable in 20 years and subject to redemption by the company at 105. The bonds will be convertible at par at the option of the holder into fully paid common stock at par. Another proposed resolution will confer upon the directors the power to utilize a portion of the authorized but unissued preferred stock of the company for the purpose of payment or adjustment of the arrears of dividends on the outstanding preferred stock. Another resolution will direct that the capital stock, which is now $50,000,000, be increased to $56,000,000 of common, and that the increase be reserved in the treasury and issued on demand to holders of the above mentioned bonds.

Cost of the Philadelphia Strike.—It is estimated that the cost of the strike of the employees of the Philadelphia Rapid Transit Company to the company is about $1,200,000; to the strikers and sympathetic strikers, about $3,000,000, and to the business community, mostly the retail dealers, about $8,000,000. The stock of the company, although strenuous efforts were made by large financial interests to sustain it, fell from 26 to 19. The effect will be probably that for the fourth consecutive year a deficit will be shown in the company's annual report.

Pacific Coast Power Company's Bonds.—N. W. Harris & Company, of New York, are offering to the public $2,000,000 of first mortgage 5 per cent bonds of the Pacific Coast Power Company, of Seattle. The company owns water rights within 20 miles of Seattle and 15 miles of Tacoma capable of developing 80,000-hp. It also owns a large majority of the common stock of the Seattle Electric Company and the Seattle-Tacoma Power Company, both of which are good dividend-paying properties. It is stated that at the present market value of the outstanding capital stock of the Pacific Coast Power Company there is an equity of about $6,700,000 over and above the bonded indebtedness. The company will sell power in the cities of Seattle, Tacoma and Everett, the present population of which is estimated at 415,000.

North Shore Electric Company.—At a special meeting of the stockholders of the North Shore Electric Company, of Chicago, held on April 20, it was voted unanimously to increase the company's outstanding capital stock from $5,000,000 to $7,000,000. The resolutions approving the making of a new first and refunding mortgage and bond issue, not exceeding $25,000,000, was adopted. The stock is now on a 4 per cent dividend rate. Stockholders have the right to subscribe at par for the new stock to the extent of 10 per cent of their holdings, but a stock bonus will be given so that the average cost of the new stock to present holders will be brought down to $70 a share.

Susquehanna Railway, Light & Power Company.—Negotiations have been practically concluded whereby the Susquehanna Railway, Light & Power Company, of Wilkes-Barre, Pa., has taken over the property of the Wilkes-Barre Power & Electric Light Company and the Wilkes-Barre Heat, Light & Power Company. The property will be extensively improved.

Florence (S. C.) Electric & Utility Company.—The plant and holdings of the Southern Public Service Company, of Florence, S. C., have been purchased by the Florence Electric & Utility Company, which was recently incorporated with an authorized capital of $100,000.

DIVIDENDS.

Amalgamated Copper Company, quarterly, ½ per cent, payable May 30.

American Gas & Electric Company, preferred, quarterly, 1½ per cent, payable May 1.

J. G. Brill Company, preferred, quarterly, 1¾ per cent, payable May 2.

Cape Breton Electric Company, Ltd., preferred, semi-annual, 3 per cent, payable May 2.

Connecticut Railway & Lighting Company, quarterly, 1 per cent, payable May 15.

Mobile Electric Company, preferred, quarterly, 1¼ per cent, payable May 14.

Montreal Light, Heat & Power Company, quarterly, 1¾ per cent, payable May 15.

National Lead Company, preferred, quarterly, 1¾ per cent, payable June 15.

West Penn Railways Company, preferred, quarterly, 1¾ per cent, payable May 2.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Dallas (Tex.) Electric Corporation:					
February, 1910	$105,199	$71,959	$33,240	$23,088	$10,151
February, 1909	94,588	57,952	36,635	25,439	11,196
Edison Electric Illuminating Company of Brockton:					
February, 1910	26,368	13,513	12,855	4,101	8,754
February, 1909	23,416	12,633	10,782	2,761	8,021
El Paso Electric Company:					
February, 1910	53,839	27,752	26,086	8,486	17,600
February, 1909	45,372	27,863	17,509	7,911	9,579
Mahoning & Shenango Railway & Light Company:					
Six months ending Feb. 28, 1910	1,054,279	592,070	462,209	244,173	218,035
Six months ending Feb. 28, 1909	905,158	562,937	342,221	233,317	108,904
Montreal Street Railway Company:					
March, 1910	336,196	220,790	115,406	43,068	72,338
March, 1909	298,728	203,832	94,896	38,901	55,995
National Light, Heat & Power Company:					
Year 1909	791,481	410,576	380,905	185,834	195,071
Year 1908	731,582	412,255	319,327	151,624	167,703
Northern Ohio Traction & Light Company:					
March, 1910	173,424	99,159	74,265	43,291	30,974
March, 1909	150,684	86,720	63,964	43,803	20,161
Northern Texas Electric Company:					
February, 1910	93,082	52,315	40,766	18,252	22,514
February, 1909	82,660	48,090	34,570	17,189	17,380
Pacific Gas & Electric Company:					
Year 1909	13,332,501	10,280,098	3,052,402	240,000	2,812,403
Year 1908	12,853,817	10,801,487	2,052,330	240,000	1,812,330
Paducah Traction & Light Company:					
February, 1910	18,771	11,776	6,994	6,954	39
February, 1909	17,807	11,068	6,738	6,934	*195
Pensacola Electric Company:					
February, 1909	19,811	11,725	8,086	4,824	3,261
February, 1910	19,081	10,123	8,957	4,366	4,591
Savannah Electric Company:					
February, 1910	45,130	27,365	17,764	16,085	1,679
February, 1909	45,855	28,233	17,621	15,746	1,874

*Deficit.

General News

Construction News.

ALEXANDER CITY, ALA.—The Russell Manufacturing Company is reported to be considering the construction of a hydroelectric power plant to furnish electricity to operate its mill.

BIRMINGHAM, ALA.—The Louisville & Nashville Railroad Company, it is reported, is planning to commence work on its new shops in Birmingham in the near future. Several buildings will be erected, including an electric power plant.

FORT MORGAN, ALA.—Bids will be received at the office of the constructing quartermaster, Fort Morgan, Ala., until May 23 for the construction of an electric lighting system at Fort Morgan, Ala. Plans and specifications, blank proposals and further information will be furnished upon application to Captain H. B. Chamberlain, constructing quartermaster. A deposit of $10 will be required for specifications, which will be returned upon return of plans.

GADSDEN, ALA.—Application for a franchise to construct an electric railway in Gadsden and to develop an amusement park at the falls has been made by H. H. Rogers, representing the Noccalula & Southwestern Railway Company, which was organized to build a railway from Gadsden to the falls in Black Creek on Lookout Mountain.

JUNEAU, ALASKA.—It is reported that the Lon De Van Mining Company will soon install a power plant at its mines on George's Inlet. Otto Lonstorf is general manager.

DOUGLAS, ARIZ.—El Tigre Mining Company is contemplating the construction of a large power plant in Douglas, which will furnish electricity to operate the cyanide plant at its mines and for an electric railway extending from Douglas to El Tigre.

LITTLE ROCK, ARK.—The Garland Power Development Company has been granted a charter by the State Board of Railroad Incorporation to construct a dam across the Ouachita River, near Ross Ford, in Montgomery County, and establish a power plant, the State reserving the right to fix at any time the charges for the transmission of electricity.

EL CENTRO, CAL.—The Holton Power Company, of Holtville, Cal., is reported to be considering the installation of a steam power plant in El Centro, the cost of which is estimated at about $75,000.

EUREKA CITY, CAL.—Preparations are being made by the Humboldt Gas & Electric Company for improvements to the Junction City plant, work on which will begin as soon as the weather will permit. William S. Clark, of Eureka, is president of the company.

HAYWARDS, CAL.—The People's Light & Power Company, which recently purchased a 35-year franchise to operate its system in Haywards, is reported to have announced that it would commence work immediately on the erection of its transmission lines from Fruitvale to Haywards. D. U. Toffelmer, of San Leandro, Cal., is president of the company.

LOS ANGELES, CAL.—At an election held April 19 the citizens voted to issue $6,500,000 in bonds, of which $3,500,000 will be used to develop the water power along the Owens River aqueduct and $3,000,000 for harbor improvements. It is estimated that about 120,000 hp can be developed.

OAKLAND, CAL.—The Board of Supervisors has awarded the People's Electric Light & Power Company a 50-year franchise to furnish electricity in Alameda County, for which the company paid the sum of $100. The company proposes to furnish electricity for lamps and motors in the towns of San Leandro and Hayward and adjacent territory in the southern portion of Alameda County. The headquarters of the company will be located in Oakland. D. W. Toffelmeir, of San Leandro, Cal., is president of the company.

OAKLAND, CAL.—Announcement has been made by the Central Oakland Light & Power Company that a base rate of 7½ cents per kw-hour will be charged to its customers. The Oakland Gas, Light & Heat Company now charges a base rate of 9 cents per kw-hour for the same amount of electricity. The new company's base rate will be accompanied by a sliding scale of prices for consumers of electricity for motors which will be as low as 3 cents per kw-hour. The lowest rate now in effect with the old company is 4 cents for the same service. The Central Oakland Light & Power Company has practically completed the laying of its high-tension cables along Broadway in the downtown districts, and is now installing the cables through Washington, Franklin and intersecting streets from the waterfront northward. The power plant, located at First and Alice Streets, will be ready for the installation of machinery within 30 days, which will include two steam turbine engine units of 1000 kw each. The company expects to have its plant ready to furnish electrical service by next September or October. E. M. Beal is general superintendent.

PARADISE, CAL.—Announcement has been made by Messrs. Hanscom & Kimball, of Paradise, who were recently granted a franchise to operate electric transmission lines over all the public roads in Butte County, that the company will erect an electric transmission system to supply electricity for lamps and motors to the settlement along the Paradise Ridge. Water rights sufficient to generate 2000 hp have been located by the company. Work will be started at once on the project. The towns of Paradise, Orloff and Magalaia will be supplied by the company.

PASADENA, CAL.—Plans are being prepared by C. W. Koiner, superintendent of the municipal electric light plant, for lighting the Pasadena parks on an elaborate scale. It is understood that cluster lamps will be used.

SAN BERNARDINO, CAL.—Plans are being considered by the Southern California Edison Company for the construction of a large power plant at Slide Lake, on Bear Creek, the cost of which is estimated at about $600,000. The plant will furnish electricity for the entire San Bernardino Valley. It is proposed to divert the water supply for the new power plant from Filaree Flats, where the New Bear Valley Mutual Water Company plans to impound the water.

SAN BERNARDINO, CAL.—The Whitewater Land & Power Company, which has taken over the water rights along the Mojave River secured by Arthur E. Poole for the purpose of establishing a large irrigation system by impounding the water of the river at Victor Narrows, including dams, ditches, etc., has transferred the property to the Consolidated Reservoir & Power Company. The last-named company has also secured the interests of the E. E. Hendrick estate in the river and a portion of the water rights of the Palm Valley Water Company.

SAN FRANCISCO, CAL.—It is understood that contracts will soon be closed for electrical equipment for further developments at Horseshoe Bend, on Battle Creek, which will include the installation of three 4000-kw units this season, utilizing a head of 440 ft. of water, making a total output of 42,000 hp between the five power stations of the company.

SONORA, CAL.—It is reported that plans are being considered for further development of the hydroelectric power plant of the Sierra & San Francisco Power Company, which is situated on the Stanislaus River, 12 miles from Sonora. The plant is owned and controlled by the United Railways Investment Company, of San Francisco, Cal.

STOCKTON, CAL.—Announcement has been made that bonds to the amount of $700,000 have been floated for the San Joaquin Valley Electric Railway, the proceeds of which will be used for the construction of the proposed electric railway. Work will commence at once on construction of the road. Morris L. Brackett is promoter, A. H. Wallace is engineer, and Harold Fenwick, of San Francisco, Cal., will be president of the company.

STOCKTON, CAL.—The Stockton Gas & Electric Corporation has decided to place its wires underground on the main streets of the city.

STOCKTON, CAL.—The City Council has decided to install a new system of street lighting on the principal business streets. The committee from the Merchants' Association has presented two propositions to the Council for the system of cluster lamps for street lighting. One calls for 220 posts, at a cost of $35,000, and the other for 286, to cost $49,400. It is expected that the lamps will be installed at once.

TRINITY CENTER, CAL.—Preparations are being made for rebuilding the electric power plant of the Trinity Water & Power Company, which was destroyed by fire last fall. The plant will furnish power to the Bonanza King mine. Frank J. Symmes, receiver of the California Safe Deposit & Trust Company, has been authorized by Judge Sewall, in San Francisco; to expend $7,000 for the plant. The power and mining companies are auxiliary corporations to the safe deposit company.

TRUCKEE, CAL.—Surveys are being made by the Truckee River General Electric Company, of Reno, Nev., for the construction of a power plant on the Truckee River, about three miles from Truckee, near the Polaris station. It is reported that the water will be carried by a flume three miles to the proposed power house site.

BOULDER, COL.—The Northern Colorado Power Company is considering plans for the extension and improvement of the Boulder street railway system. The cost of the work is estimated at $50,000. W. J. Barker, of Denver, Col., is president of the company.

DENVER, COL.—The Denver Gas & Electric Company has placed orders for a horizontal type 5000-kw Curtis turbo-generator set. This machine will replace two direct-current belted generators and engines.

DENVER, COL.—Work has been suspended temporarily on the large dam at Nederland of the Central Colorado Power Company, owing to the burning out of the transformer station, caused by lightning. The loss is estimated at $10,000.

DENVER, COL.—The erection of a new transmission line has been authorized by the directors of the Northern Colorado Power Company between the plants at Lafayette and Greeley, and also other extensive improvements, which will involve an expenditure of about $250,000. The new line will take in Fort Lupton, Brighton and all towns along the Union Pacific Railway. A transmission line now being erected in this direction from Evans is to be continued on toward the power plant along the route of the Denver, Laramie & Northwestern Railway. W.

J. Barker is president of the company and C. H. Williams, manager, both of Denver, Col.

MIDDLETOWN, CONN.—Bids are being received by Henry Floy, 165 Broadway, New York, N. Y., consulting engineer, for the construction of a 1500-hp power plant for the Middletown Electric Light Company, of Middletown, Conn., to be erected this summer in Middletown. The power house is designed for an ultimate output of 3000 hp.

NEW HAVEN, CONN.—The directors of the New Haven Hospital have authorized the installation of a new electric power and heating plant, plans for which have been completed. It is understood that work will soon commence on construction of the plant.

NEW HAVEN, CONN.—Preparations are being made by the United Illuminating Company, of New Haven, for the construction of a two-story addition to its power station on Grand Avenue, 57 ft. x 65 ft., which will be equipped with a 1000-hp Parsons steam turbo-generator set and a 300-hp Babcock & Wilcox boiler. New equipment will be installed in the George Street power station, including a 750-hp, Ball reciprocating engine direct connected to two 250-kw direct-current generators.

DELAWARE CITY, DEL.—The city has decided to replace the oil lamps now in use for street lighting with electric lamps and has entered into a contract with the American Light & Power Company to furnish 100-cp tungsten lamps for lighting the streets, the town guaranteeing that minimum cost of the service will not be less than $1,000 per year. The contract is for a period of 15 years.

WASHINGTON, D. C.—It is reported that a central heating, lighting and power plant will be erected by the Catholic University at a cost of about $75,000.

ATLANTA, GA.—Application has been filed by the Yellow River Power Company in the superior court for a charter. The company will be capitalized at $90,000, the privilege being asked to increase it to $1,000,000 if desired. The company proposes to construct a hydroelectric power plant on the Yellow River, on what is known as the old Anniston property, about 4½ miles from Stone Mountain, Ga. A concrete dam will be constructed across the river at that point, where it is estimated that about 1500 hp can be developed. The incorporators are: S. H. Venable, S. E. Smith and J. B. McCrary.

COLLEGE PARK, GA.—At an election to be held May 30, the proposition to issue $65,000 in bonds, the proceeds to be used for the construction of a municipal electric plant, water works and sewer systems will be submitted to a vote.

DUBLIN, GA.—The City Council is contemplating calling an election to vote on the proposition to issue from $40,000 to $50,000 in bonds, the proceeds to be used to improve and enlarge the municipal electric light plant.

FORT OGLETHORPE, GA.—Bids will be received until May 4 at the office of the constructing quartermaster, Fort Oglethorpe, Ga., for enlargement and addition of boiler and pump house, including cold storage and ice plant at this post. For further information address George Vidmer, constructing quartermaster.

LAWRENCEVILLE, GA.—The City Council has entered into a contract with McCrary & Company, of Atlanta, Ga., for lighting the town for a term of 10 years beginning Jan. 1, 1911. The company has recently acquired the property of the Anniston mills, located on the Yellow River, 12 miles south of Lawrenceville, which it proposes to develop at a cost of about $150,000.

BUHL, IDAHO.—The Clear Lake Orchard Company is contemplating the installation of a power plant with sufficient output to supply heat and power to the Twin Falls and North Side tracts.

IDAHO FALLS, IDAHO.—At an election held recently the proposition to issue $95,000 in bonds for the construction of an electric light plant and water works was carried. It is understood that a hydroelectric power plant of 1000 hp will be built. L. C. Kelsey, of Salt Lake City, Utah, is engineer in charge.

KOOSKIA, IDAHO.—It is understood that a power plant will be installed on the Middle Fork River in the near future by a Chicago company, headed by Mr. Day, of the Marshall Field Company.

BRAIDWOOD, ILL.—The Village Council has granted the Economy Light & Power Company, of Joliet, Ill., a 50-year franchise to construct and operate an electric light plant in Braidwood. It is understood that the company will purchase the municipal electric light plant, which has proved a failure in this village. It is reported that the municipal water works system will also be disposed of to a private corporation.

CHICAGO, ILL.—The directors of the Atchison, Topeka & Santa Fe Railway Company have approved plans for expenditure of $31,000,000 this year, of which $500,000 will be used to complete installation of telephone system for train despatching.

CHICAGO, ILL.—The stockholders of the North Shore Electric Company are reported to have authorized an increase in the capital stock from $5,000,000 to $7,000,000 and an issue of $25,000,000 first refunding general mortgage bonds, under a blanket mortgage on the property. It is understood that no new stock will be issued for some time. The proceeds from the sale of securities will be used entirely for expansion and improvements to the property.

COAL CITY, ILL.—The Economy Light & Power Company, of Joliet, Ill., is reported to have submitted a proposition to the City Council offering $16,400 for the municipal electric light plant, basing its price on two years' earnings of the plant. The income from the plant last year was $8,200. The company offers to furnish electricity for street arc lamps at the rate of $65 per lamp per year and to furnish electrical service for commercial and domestic purposes at 13 cents per kw-hour.

CORNELL, ILL.—It is reported that a company is being organized to establish a public service plant in Cornell, for which generating machinery will be required. Abel R. Gourley is interested in the project.

DECATUR, ILL.—The citizens on April 19 voted in favor of the proposition to issue $75,000 in bonds, the proceeds to be used for improvements and extensions to the municipal electric light plant. Albert Leach is city clerk.

FRANKLIN PARK, ILL.—Sealed proposals will be received by Village of Franklin Park, Ill., until May 2 for construction of a reinforced concrete pumping station and centrifugal pumps, motors, etc. Plans and specifications are on file at the office of H. L. Emerson, engineer, 118 Chamber of Commerce Building, Chicago, Ill., and at the office of K. W. Pelsma, village clerk, Franklin Park, Ill.

FREEPORT, ILL.—Preparations are being made by the Freeport Telephone Exchange Company for rebuilding its entire system, including the installation of a new switchboard for both the local and long-distance service and an entire new power plant. L. Z. Farwell is president and Roy K. Farwell, secretary and manager.

HARRISBURG, ILL.—G. E. Hixon, representing the Egyptian Traction Company, which proposes to construct an electric railway from Cairo, Ill., to Terre Haute, Ind., has applied for a franchise through Harrisburg.

MARION, ILL.—A company has been incorporated to build an electric railway from a point on the Chicago, Burlington & Quincy Railroad, two miles southwest of Marion, Ill., to and through Marion to Johnson City on the Chicago & Eastern Illinois Railroad. The directors are: A. E. Harper, W. D. Hoyne, E. J. Hughes, L. D. Doty and C. S. Brockett, of Chicago, Ill.

PEORIA, ILL.—Plans are being made by the Peoria Railway Terminal Company for the installation of duplicate generating units with a rating of 1500 kw.

ANDERSON, IND.—We are informed that the Indiana Union Traction Company contemplates the purchase of a 2500-kw, low-pressure turbine for its power house in Anderson in the near future. H. A. Nicholl, of Anderson, Ind., is general manager.

BEDFORD, IND.—The Bedford Power Company has engaged the Esterline Company, of Lafayette, Ind., of which J. W. Esterline is president and manager, as consulting and supervising engineer of its proposed hydroelectric power plant, which it proposes to construct on the south fork of the White River, near Williams, Ind. Electricity generated at the plant will be transmitted to the stone district of Bedford, Ind.

BEECH GROVE, IND.—Specifications have been issued by the Big Four Railroad for construction work at Beech Grove, which will involve an expenditure of about $1,000,000. The plans call for construction of water works, including water, sewer and fire systems, conduits for heat and power transmission, a reservoir and other facilities.

CARTHAGE, IND.—F. F. Brenen and associates, of Parkersburg, W. Va., have purchased the Carthage light, heat and power plant at receiver's sale and have taken charge. Mr. Brenen announces that the property will be improved and some new machinery installed. It is understood that bids will soon be asked for additional equipment.

EVANSVILLE, IND.—Preparations are being made by the Evansville Gas & Electric Light Company for extensive improvements and additions to its electric power located at Main and Division Streets, which will involve an expenditure of about $125,000 and will increase the output to 5000 kw. The equipment will include a 2000-kw turbine furnished by the Allis-Chalmers Company, of Milwaukee, Wis., and two tubular boilers with a rating of 600 hp each, contract for which has been placed with the Babcock & Wilcox Company, of New York, N. Y. Contracts have also been placed for two Worthington feed water pumps and a large Westinghouse turbine-driven exciter set and other equipment. The company is also preparing to erect another complete circuit in the city, for which 10 miles of copper wire has been ordered. A. C. Blinn is general manager.

FRANKFORT, IND.—The Kramer Brothers Company, of Frankfort, Ind., is reported to be contemplating the installation of alternating-current motors to operate the machinery in its planing mill.

INDIANAPOLIS, IND.—Plans are being considered by the Terre Haute, Indianapolis & Eastern Traction Company for the construction of a large power plant and car shops in Indianapolis, at a cost of about $1,000,000. The proposed power house will be located in West Tenth Street, just west of the Belt Railroad. The new plant will eventually have an output of 40,000 kw and will supply electricity for the interurban railways. All of the present power plants on all the lines will be maintained, the new plant furnishing additional power. The car shops will be erected on West Washington Street in connection with the present car barns. Hugh J. McGowan, of Indianapolis, is president.

LA GRANGE, IND.—Arrangements are being made by the Northern Indiana & Southern Michigan Telegraph & Cable Company for the installation of a new telephone system in LaGrange. The common battery system will be installed. F. C. Morrill is manager.

SOUTH BEND, IND.—Plans have been prepared for the new power house of the Indiana & Michigan Electric Company in South Bend by

Austin & Shambleau. The cost of the plant is estimated at $40,000, and no general construction contracts will be awarded for same. The new plant will be erected on the site of the old power house, which will be discarded as soon as the new building is completed.

ALLERTON, IA.—L. G. Knapp & Company, consulting engineers, New York Life Building, Kansas City, Mo., have been engaged to prepare plans and superintend the construction of an electric light plant in Allerton. The cost of the plant is estimated at $12,000.

DAVENPORT, IA.—The City Council has granted the Iowa & Illinois Railway Company, of Clinton, Ia., a franchise to construct and operate an electric railway in Davenport.

DES MOINES, IA.—Plans are nearly completed for the Drake Park Exchange Building of the Iowa Telephone Company, the cost of which is estimated at $35,000.

DES MOINES, IA.—The capital stock of the Iowa Telephone Company has been increased from $4,000,000 to $10,000,000, the proceeds to be used for retiring bonds and to pay other indebtedness and to provide for increase in business. G. E. McFarland is general manager.

IRETON, IA.—Contracts have been placed by the Ireton Electric Light & Power Company for complete equipment for an electric light plant to be installed in this town. The company is composed of local business men. It is expected to have the plant in operation about July 1.

WATERLOO, IA.—The directors of the Waterloo, Cedar Falls & Northern Railway Company have authorized an expenditure of $285,000 for improvements and extensions to the system, which will include an addition to the present power house increasing the output from 1000 hp to 3000 hp, construction of a new interurban line to Waverly, and double-tracking several lines in Waterloo. L. S. Cass is president of the company.

JAMESTOWN, KAN.—The contract for the construction of water works and lighting plant has been awarded to Lund & Cunyon, of Blackwell, Okla. The cost of the work is estimated at about $15,000. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are consulting engineers.

LAWRENCE, KAN.—Henry Bowman, of Lawrence, Kan., has secured the contract for the construction of a concrete dam in Russell, plans for which were prepared by Burns & McDonnell, Kansas City, Mo., consulting engineers.

NEODESHA, KAN.—The citizens are reported to have voted to issue bonds for the construction of a municipal electric light plant in Neodesha.

DOWNS, KAN.—The plant and holdings of the Downs Electric Light & Power Company are reported to have been purchased by C. A. Brekord, of Lexington, Mo.

WICHITA, KAN.—Plans are being prepared by Burns & McDonnell, Scarritt Building, Kansas City, Mo., for the construction of a concrete dam across the Arkansas River at Wichita, Kan., the cost of which is estimated at about $25,000.

CAMPTI, LA.—The Campti Telephone & Electric Light Company, recently organized with a capital stock of $10,000, proposes to take over the local telephone exchange and extend the telephone lines to Creston, and possibly to Alpha and Treschel, La.

ROCKLAND, MAINE.—The Rockland, Thomaston & Camden Street Railway Company is building an addition to its power house, in which will be installed a new 500-kw generator direct connected to a 700-hp cross compound engine. The service is also to be improved between Camden and Rockland by the installation of 51,000 lb. of new copper wire.

RUMFORD FALLS, MAINE.—The Rumford Falls Power Company has awarded the contract for enlargement of its plant to the H. P. Cummings Construction Company, of Ware, Mass. The contract includes all cofferdams, ledge excavation, concrete foundation and construction of brick power house for additional development of 7500 hp.

WELLS, MAINE.—At a town meeting held recently the citizens voted to rescind the appropriation of $20,000 for the construction of a municipal electric light plant and to postpone indefinitely all propositions for street lighting. The Wells Electric Light & Power Company submitted a proposition to the town of Wells offering to supply 100 tungsten series street lamps of 25 cp for a term of 10 years at the rate of $10 each per year, the lamps to burn every night until midnight, and $5 per lamp for summer service, to burn four months in the year; $4 per lamp for lamps to burn three months in the year. The lamps to be located within a reasonable distance of the main lines, location to be designated by the town officials. Or, if the town decides to install its own system and maintain the same, the company offers to furnish electricity at 3½ cents per kw-hour for yearly service and 7 cents per kw-hour for summer service. Where pole line is built for joint occupancy by the town and company, the latter offers to pay 50 per cent of the cost of maintenance.

BALTIMORE, MD.—Beginning with May 1 the Consolidated Gas, Electric Light & Power Company will reduce the price for electricity furnished in the county within a radius of about 15 miles, beginning at the county line on the Reisterstown Pike, and extending to Owings Mills, taking in the Green Spring Valley, Pikesville and other settlements, from 15 cents to 10 cents per kw-hour. The new rate is the maximum charge and applies to amounts of 50 kw and less per month.

THURMONT, MD.—The city is reported to be contemplating the purchase of the plant of the Citizens' Electric Light & Power Company, now in course of construction. Bonds to the amount of $18,000 were recently voted to establish a municipal electric light plant. William J. Freeze is president of the Board of Town Commissioners.

ATTLEBORO, MASS.—The Attleboro Steam & Electric Company has notified the Selectmen of a substantial reduction in the price for lamps for street lighting, which will result in a saving of $460 a year to the town, the new schedule to take effect from April 1, 1910. The price for 40-cp incandescent lamps has been reduced from $18 to $17.50 and arc lamps from $72.50 to $70 each per year.

NORTH ADAMS, MASS.—It is reported that a large power scheme is under consideration by parties interested in the Deerfield River Power Company, which includes the erection of a large power plant at Zoar and furnishing electricity to operate trains through the Hoosac Tunnel and the narrow gage road at Wilmington. The plans call for the construction of a large dam at Monroe Bridge and the tunneling of Davis Mountain to carry the water to Zoar. It is said that water rights have been purchased along both sides of the river between Monroe Bridge and Zoar. Martin A. Brown, of Boston, Mass., is reported to be one of the promoters of the Deerfield Company.

ORANGE, MASS.—The Orange Electric Light Company is constructing a new concrete dam, 190 ft. long and 20 ft. high, on the Millers River. The power plant equipment will include three sets of water wheels installed in an open flume direct connected to generators and an auxiliary steam engine equipment. Sluice gates operated from a gallery inside the dam are provided for use in times of high water. The plant has a rating of 900 hp and is expected to be ready for operation in June. The construction work is being done under the supervision of F. B. Saunders. William D. Thompson is consulting engineer.

READING, MASS.—A special town meeting will soon be called to authorize the municipal electric light commissioners to extend the electric light service to North Reading. The cost of the extension is estimated at $1,350. The street lighting service will cost the town of North Reading $1,500 per year.

THREE RIVERS, MASS.—The H. P. Cummings Construction Company, of Ware, Mass., has secured the contract for the construction of power development of the Palmer Mill of the Otis Company, at Three Rivers, Mass. The contract includes the construction of a concrete dam 40 ft. high and 250 ft. long and a brick power house 100 x 90 ft.

DETROIT, MICH.—The Detroit United Railway Company is reported to be contemplating the construction of new crosstown lines, consisting of about four miles of track at a cost of approximately $400,000. T. W. Brooks is general manager.

MUNISING, MICH.—The Munising Paper Company, Ltd., is planning to construct a new power plant, the equipment of which will include boilers, engine and electrical apparatus.

ANOKA, MINN.—At an election held April 19 the proposition to issue $45,000 in bonds for the construction of a dam on Rum River, in connection with the municipal electric plant, was defeated.

FARIBAULT, MINN.—The plant and holdings of the Faribault Gas & Electric Company are reported to have been taken over by the Consumers' Power Company, which, it is said, will improve and extend the service.

GRANITE FALLS, MINN.—It is reported that the city is contemplating purchasing the water power owned by Mr. Rustard, of Kindred, N. D., for $3,750.

KEEWATIN, MINN.—The Village Council is reported to be considering the construction of a municipal electric light plant in Keewatin.

LITTLE FALLS, MINN.—The Pike Rapids Power Company is reported to have been authorized by Congress to construct a dam across the Mississippi River in Morrison County.

PELICAN RAPIDS, MINN.—The proposition to issue $5,000 in bonds, the proceeds to be used for improvements to the municipal electric light plant, will be submitted to a vote.

SARTELL, MINN.—The Watab Pulp & Paper Company, of Sartell, Minn., has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for power equipment for the addition to its plant, which will practically double the output of the original installation. The equipment will include a 560-kw, 440-volt, three-phase, 60-cycle, water wheel generator, a 300-kw, synchronous motor generator set, a 300-hp, 240-volt, variable speed, direct-current motor, one 150-hp, one 100-hp, one 50-hp and one 40-hp, wound rotor induction motors, two 40-hp, two 30-hp and one 7½-hp, squirrel cage induction motors, one 35-hp and one 7½-hp, direct-current, variable speed motors.

SPRING VALLEY, MINN.—W. J. Pulford, of Sioux Rapids, Ia., has purchased the local electric light plant and proposes to develop a water power located about 5½ miles from the town, where a head of 55 ft. can be secured. A concrete dam and penstock will be built and large water wheels installed. It is proposed to organize a company with a capital stock of $50,000 to carry out the project.

STILLWATER, MINN.—Extensive improvements are being made by the Consumers' Power Company in its gas and electric plants in this city, which will include the extension of the electric transmission and the construction of 13 miles of new gas mains.

VERNDALE, MINN.—The Verndale municipal electric light plant is reported to have been sold to H. M. Hicks.

CLARKTON, MO.—It is reported that an electric light plant will be installed in Clarkton. W. P. Whisett, of Rector, Ark., is interested in the project.

HIGGINSVILLE, MO.—The city is contemplating increasing the output of the municipal electric light plant and water works system. Frank Monser is superintendent.

KANSAS CITY, MO.—The Kansas City Railway & Light Company is contemplating the purchase of new substation equipment and the construction of a new power house at Forty-eighth Street and Troost Avenue, Kansas City. W. W. Wheatley is general manager.

PALMYRA, MO.—At an election to be held May 18 the proposition to issue bonds to the amount of $35,000, the proceeds to be used to construct or acquire an electric light plant will be submitted to a vote.

SAVANNAH, MO.—At an election held recently the citizens voted in favor of granting a franchise to Frank C. Barrington, of St. Joseph, to furnish electricity in Savannah. The franchise includes the use of the municipal electric light plant.

ST. LOUIS, MO.—The Laclede Gas Light Company is reported to be contemplating making additions to its plant, which will include the installation of boilers and electrical equipment.

TIPTON, MO.—A committee appointed by the citizens is securing estimates of the cost of installing a municipal electric light plant with a view of calling an election to vote on the proposition to issue bonds for the construction of the same. The cost of the plant is estimated at about $15,000. Joseph Sommerhauser is city clerk.

WEBSTER GROVES, MO.—The warehouse and barns of the Suburban Electric Light & Power Company were destroyed by fire recently, causing a loss of about $15,000.

WESTBORO, MO.—The citizens have voted to instruct the Town Council to establish a municipal light plant.

FORT MISSOULA, MONT.—Sealed bids will be received by A. B. Shattuck, constructing quartermaster, Fort Missoula, Mont., for construction of electric light system as follows: First—For furnishing and installing meters and fixtures in 11 sets of officers' quarters, 4 sets of non-commissioned officers' quarters, 2 double barracks, 1 stable, 1 bakery, 1 post exchange and gymnasium. Second—The construction of a street line, service connection to buildings, including all necessary items for same. Third—Furnishing and installing tungsten lamps, switchboards and all apparatus necessary for substation. Fourth—Construction of reinforced concrete building for transformer station.

HAMILTON, MONT.—The Montana Independent Telephone Company has purchased a site on which it will erect an exchange building at a cost of about $15,000.

MILES CITY, MONT.—Plans are being prepared by Burns & McDonnell, Scarritt Building, Kansas City, Mo., consulting engineers, for municipal electric light plant, water works system and sewers for the City of Miles, for which the city recently voted to issue $250,000 in bonds. Water will be taken from the Yellowstone River, using settling basins and filtration. Bids for construction will be called for in about six weeks.

ALLIANCE, NEB.—At an election held recently the proposition to appropriate $75,000 to purchase the local electric light plant and enlarge the water works system was carried.

BELGRADE, NEB.—At an election held April 5 the citizens voted in favor of the proposition to install an electric lighting plant and water works system.

HAVELOCK, NEB.—The Omaha, Western & Lincoln Railroad Company has been granted a franchise by the Council to construct a railway in Havelock. The company proposes to construct a railway from Omaha to Hastings, a distance of 219 miles. Applications for franchises have been made to other towns along the route. Frank F. Schaaf is president and general manager.

OMAHA, NEB.—Preparations are being made by the Nebraska Traction & Power Company to extend its railway from Ralston to Papilion this spring.

OMAHA, NEB.—Bids will be received by D. M. Haverly, city clerk, until May 14 for a high and low-pressure power and heating apparatus, ventilating apparatus, electric motors, plumbing, sewerage and gas piping for the court house for Douglas County, under the new plans prepared.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 3750-kw, three-phase, 25-cycle, 1320-r.p.m., 13,200-volt, steam turbo-generator set.

ST. EDWARD, NEB.—C. F. Smith is reported to have purchased a site and water rights for a hydroelectric plant and will commence work on the construction of an electric light and power plant in the near future.

STERLING, NEB.—The Drummond Electric Company, of Lincoln, Neb., is reported to have been granted a franchise by the City Council to construct and operate an electric light plant in Sterling. The cost of the proposed plant is estimated at about $18,000, work on which will begin at once.

NEWARK, N. J.—The committee on municipal lighting has recommended to the Common Council an extension of the city hall lighting plant so as to furnish electricity to light the buildings in proximity to the city hall plant as advised by Duncan and Lyndon, consulting engineers. The cost of the work is estimated at about $6,000.

FORT BAYARD, N. M.—Contracts for the construction of a cold storage and electric power plant at Fort Bayard have been awarded to J. A. Harlan, of Fort Bayard, N. M., for $33,322.

LAS VEGAS, N. M.—Plans are being prepared by the Ria La Casa Power Company for the construction of a power plant at Ria La Casa, on La Casa River, during the coming summer. W. G. Benjamin is secretary of the company, and John L. Zimmerman, of East Las Vegas, N. M., engineer.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company has petitioned the Board of Estimate for a franchise to operate a railway over the Manhattan Bridge and through Canal Street, Manhattan.

BROOKLYN, N. Y.—Application has been made to the Board of Estimate by the City & Suburban Railway Company for a franchise to construct and operate an electric railway from Brooklyn to Amityville; also to operate a spur from the Ridgewood Reservoir to Jamaica Bay.

BROOKLYN, N. Y.—Bids will be received until May 6 by R. Waldo, fire commissioner, for furnishing material and labor for constructing and equipping an underground fire alarm system in the Borough of Brooklyn. Blank forms and further information may be obtained at the office of the Fire Department, 157 and 159 East Sixty-seventh Street, Manhattan, N. Y.

EAST CREEK, N. Y.—The Public Service Commission, Second District, has authorized the East Creek Electric Light & Power Company to mortgage all its property, estates and franchises to the New York Trust Company to secure an issue of $3,000,000 in bonds. The company is authorized to issue at present $1,750,000 in bonds at not less than 85, the proceeds to be used to retire outstanding bonds, payment of obligations, the purchase of additional lands and water power, new power plant and extensions to its property. The company is given permission to increase its capital stock from $200,000 to $500,000, the proceeds to be used for payment of money advanced for organization expenses and purchase of additional lands for East Creek development. The company now operates an electric plant at East Creek and supplies electricity in St. Johnsville, Fort Plain, Nelliston, Canajoharie and Palatine Bridge. The company is making arrangements to supply the Fonda, Johnstown & Gloversville Railroad Company with 7500 hp. It is also contemplating the development of additional water power at Inghams Mills, on East Canada Creek, where it is estimated that 15,000 hp can be developed.

LONG ISLAND CITY, N. Y.—Bids will be received by Lawrence Dresser, president of Borough of Queens, until May 5, for furnishing and installing electric combination and gas lighting fixtures in the Queens County court house, Long Island City, N. Y. Plans and drawings may be seen and forms of contract and specifications obtained at the office of the president, Borough Hall, Long Island City, N. Y.

NEWBURGH, N. Y.—The Orange County Traction Company has applied to the Public Service Commission, Second District, for authority to issue a mortgage for $750,000. The company proposes to issue $250,000 in bonds, the proceeds to be used for improvements to the property.

ROME, N. Y.—Right of way is being secured by the Rome & Oneida Electric Railway Company for its proposed electric railway to connect Verona, Blackman's Corners, Greenway, Hatches Corners and Rome, 13 miles in length. Dewitt C. Hadcock is interested in the project.

TONAWANDA, N. Y.—Extensive additions are being made to the plant of the National Roofing Company, which will involve an expenditure of from $25,000 to $35,000, and include the erection of a paint shop and a varnish shop. The plant will be equipped for electrical operation, including the installation of electric hoists.

CHARLOTTE, N. C.—Contracts have been awarded by the Southern Power Company to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for steam power plant equipment for three auxiliary plants of 10,000 hp each. One of the plants will be located at Greenville, S. C., the location of the other two to be decided upon later.

CLIFFSIDE, N. C.—Surveys are being made for the proposed electric railway to connect Forest City and Cliffside, which later will extend to Gaffaney, S. C.

TARBORO, N. C.—The question of increasing the output of the municipal electric light plant is reported to be under consideration.

WINSTON-SALEM, N. C.—The Fries Manufacturing & Power Company is reported to have purchased a site on which it proposes to erect a transformer station to supply electricity to operate its glass factory and other plants.

FARGO, N. D.—Bids will be received by W. A. Yoder, secretary of the North Dakota Agriculture College, Fargo, N. D., until May 10 for the construction and completion of an electric light plant for the college. Plans and specifications may be seen at the office of the secretary, Fargo, N. D., and at the Builders' Exchanges at Minneapolis, St. Paul, Duluth, Minn., and Omaha, Neb.

FARGO, N. D.—The plant and holdings of the Union Light, Heat & Power Company have been purchased by the H. M. Byllesby Company, of Chicago, Ill. Extensions and improvements are contemplated by the new owners, which will include the installation of generating machinery and extension of transmission lines, and also extension of the gas system in Moorhead. Samuel Kahn is manager.

LIDGERWOOD, N. D.—It is reported that the installation of a complete street lighting system in Lidgerwood has been decided upon.

CHILLICOTHE, OHIO.—Extensive improvements are contemplated by the Scioto Valley Traction Company, which operates an electric railway between Columbus and Chillicothe, Ohio, which includes the erection of a new power station in Chillicothe, at a cost of about $25,000.

CLEVELAND, OHIO.—Plans have been prepared by John W. Seaver, of Cleveland, Ohio, for the new plant of the D. Connelly Boiler Com-

pany, which will be erected in East Cleveland, Ohio. Contracts for construction of same will soon be awarded. The equipment will include a 30-ton electric crane and an engine and generator.

COLUMBUS, OHIO.—Bids will be received by the Board of Managers of the Ohio Penitentiary until May 14 for switchboard and connecting cables for controlling alternating-current generators in the power house now being built by the Ohio Penitentiary. Plans are on file and can be secured at the offices of Marriot & Allen, architects, 20 East Broad Street, Columbus, Ohio, and the Osborn Engineering Company, engineers, Osborn Building, Cleveland, Ohio. George U. Marvin is secretary Board of Managers.

McCONNELLSVILLE, OHIO.—The City Council has granted the Muskingum & Morgan Railway Light & Power Company a franchise to construct and operate an electric railway in McConnellsville. The company proposes to build a railway from Zanesville to Duncan Falls, Ohio.

MT. VERNON, OHIO.—Plans are being prepared for the construction of a new power plant for the Mt. Vernon Railway & Light Company, for which a site has already been purchased. The extension of the railway to the grounds of the new tuberculosis hospital is also under consideration. N. C. L. Kachelmacher owns a controlling interest in the company.

BOLEY, OKLA.—Arrangements are being made by the Boley Light & Power Company, recently incorporated, for the installation of a lighting system for a population of about 2500. A power house, 24 x 45 ft., will be erected. It is understood that part of the machinery has been secured. J. R. Reynolds, P. O. Box 347, Marshall, Tex., has charge of the construction of the plant.

CHEROKEE, OKLA.—Plans and specifications are being prepared by Burns & McDonnell, Scarritt Building, Kansas City, Mo., consulting engineers, for the construction of an electric light plant, water works and sewers in Cherokee, Okla., for which bids for construction will be asked in about six weeks.

HYDRO, OKLA.—The contract for the construction of the municipal electric light plant is reported to have been awarded to R. M. Evans. The cost of the plant is estimated at $25,000.

MOUNTAIN VIEW, OKLA.—The Board of Town Trustees will receive bids until May 4 for the purchase of $10,000 electric light bonds. D. E. McBride is town clerk.

MUSKOGEE, OKLA.—Franklin Miller, S. A. Lanning and T. Bixby, of Muskogee, Okla., are reported to be interested in a project to construct a large power plant on the Illinois River, near Tahlequah, and furni h electricity in Muskogee and other towns and cities in Eastern Oklahoma.

WETUMKA, OKLA.—Bids will be received by the City of Wetumka, Okla., until May 6 for furnishing material and construction of an electric light plant and water works system in Wetumka. The work will include one alternating-current generator, two boilers, an engine, steam fire pump, centrifugal pump and motor, three miles of transmission line, arc lamps, etc.; also five miles of cast iron pipe, 50 fire hydrants, 40 valves and boxes, one 60,000-gal. tank and tower. Plans and specifications furnished on application to the city engineer, for which a deposit of $5 will be required.

AMITY, ORE.—Preparations are being made by the Amity Light & Power Company to resume work on the construction of its water power project, which was abandoned last winter on account of the weather. The company contemplates extending its transmission lines to furnish electricity for lamps and motors in Sheridan, Willimina, Perrydale and Ballston. J. R. Wheeler is manager.

FALLS CITY, ORE.—Negotiations have been completed whereby the Dallas Telephone Exchange will take over the property and holdings of the Falls City Exchange. The entire system will be rebuilt, including new poles, cable, switchboard and instruments. The price paid for the system is understood to be about $20,000. A. L. Sundberg is manager of the Dallas Exchange, and D. J. Pugh will have charge of the Falls City office.

HERMISTON, ORE.—Application has been made to the City Council by J. S. West, of Hermiston; John Nissen and Julius Beeman, of Pendleton, Ore., who have recently formed a company to erect an electric light and power plant in Hermiston, for a franchise to construct and operate an electric system in this city. The General Electric Company, of Portland, has also applied to the Council for a franchise to furnish electrical service.

HOOD RIVER, ORE.—A petition signed by leading citizens of Hood River has been presented to the City Council asking that a special election be called to vote on the proposition of purchasing the water system of the Hood River Electric Light, Power & Water Company. The company offers to sell the plant for $40,000.

THE DALLES, ORE.—The City Council has granted E. W. Thomas a franchise to construct and operate an electric railway system in The Dalles.

EASTON, PA.—Arrangements have been made for placing the Easton & Washington Traction and the Northampton Traction Company under one management in the near future. The first-named company operates an electric railway from Phillipsburg to Port Murray, N. J., a distance of 18 miles, and contemplates extending east to obtain connections across the State to Jersey City. The Northampton Traction Company's railway extends from Easton to Nazareth and to Bangor, Pa., with connections to Portland. The construction of a railway from Portland to Delaware Water Gap, four miles in length, is contemplated, giving connections from Philadelphia to Stroudsburg.

HARWOOD, PA.—Preparations are being made by the Harwood Electric Power Company to erect a private telephone line from its power plant in Harwood to Danville.

JOHNSTOWN, PA.—We are informed that the Southern Cambria Railway Company expects to place contracts within the next 30 days for a 1000-kw unit, including generators, engine and boilers, for 1200-volt, direct-current operation. Contracts will also be placed for the construction of about 13 miles of single track. F. R. Newman, of Johnstown, Pa., is general manager.

MEYERSDALE, PA.—It is reported that a movement is on foot to install a new electric light plant in Meyersdale to compete with Meyersdale Electric Light, Heat & Power Company.

MIDDLECREEK, PA.—The Middlecreek Valley Telephone Company is contemplating the erection of rural telephone lines and has taken steps to secure rights of way and franchises in Selinsgrove and Middleburgh. The first lines will be built between Selinsgrove and Middleburgh, and thence to Penns Creek. The cost of the extensions is estimated at about $25,000. Frank A. Eyer, of Dundore, is manager of the company.

MILTON, PA.—Work has commenced on the construction of the new electric power plant of the Milton Electric Light & Power Company in Milton.

NEW PHILADELPHIA, PA.—The American Sheet & Tin Plate Company is making extensive additions to its plant and will install additional equipment, including a 50-ton electric crane.

TITUSVILLE, PA.—The Titusville Electric Light & Power Company is contemplating increasing the output of its plant at a cost of from $12,000 to $13,000. An order has been placed with the Titusville Iron Company for a 250-hp gas engine which will be direct connected to a 125-kw, three-phase, 60-cycle, 2300-volt General Electric generator. It is expected to have the improvements completed by Sept. 1.

WILKES-BARRE, PA.—It is reported that financial arrangements have been completed whereby the Susquehanna Railway, Light & Power Company, of Wilkes-Barre, Pa., has taken over the property and holdings of the Wilkes-Barre Power & Electric Light Company, of Wilkes-Barre, and several subsidiary companies operating systems in suburban towns and the Wilkes-Barre Heat, Light & Power Company. The new company, it is stated, contemplates making improvements to several of the plants.

SAN JUAN, P. R.—Sealed proposals will be received at the office of the Commissioner of the Interior, San Juan, P. R., until May 18, for furnishing all material and erecting three telephone lines complete; one from Guayama to the Patillas dam site, a distance of about nine miles; one from Juana Diaz, via Villalba, to Toro Negro tunnel, about 12 miles in length, and one from Guayama to Carite tunnel, about 10 miles long. The estimated cost is about $150 per mile. Plans and specifications may be seen at the above office and at the office of the Porto Rico Irrigation Service, Guayama, P. R. B. M. Hall is chief engineer of the Porto Rico Irrigation Service. John A. Wilson is Commissioner of the Interior.

PROVIDENCE, R. I.—Plans are being considered by the New York, New Haven & Hartford Railroad Company to double-track the electric line of the Warren & Bristol branch, between Warren, R. I., and Fall River, Mass., and also to double the output of the power station of the division. The railroad was originally operated by steam.

AIKEN, S. C.—It is reported that the Seaboard Air Line Railroad is planning to secure an entrance to Aiken by the means of an electric railway or interurban system. It is intimated that the railroad company may purchase the Augusta-Aiken Railway Company's system and operate the same.

BEAUFORT, S. C.—Plans have been completed for the proposed new municipal electric light plant, bids for construction of which will soon be advertised for.

EASLEY, S. C.—At an election held April 18 the proposition to issue $30,000 in bonds, the proceeds to be used for the installation of a municipal electric light plant and water works system, was carried.

FLORENCE, S. C.—The Florence Electric & Utility Company, recently incorporated with a capital stock of $100,000, has purchased the plant and holdings of the Southern Public Service Company in Florence. The officers of the new company are: Andrew P. Maloney, of Philadelphia, Pa., president; P. A. Willcox, of Florence, S. C., vice-president, and C. L. Ritchie, secretary and treasurer.

GEORGETOWN, S. C.—The City Council has granted a renewal of the electric lighting franchise held by the Georgetown Railway & Light Company for a term of 30 years. H. C. Case, of Philadelphia, Pa., is president, and Elmer E. Case, electrical superintendent.

SENECA, S. C.—The Seneca Light & Power Company, recently incorporated, is reported to be considering the construction of a power plant on Conneross Creek, where it is estimated that from 500 to 700 hp can be developed. The company proposes to furnish electricity for manufacturing plants.

BRISTOL, TENN.—The Mayor and Board of Aldermen have awarded a contract to Theodore Swann for street lighting for a term of 10 years, under the terms of which he is to furnish the city with arc lamps at the rate of $60 each per year and 32-cp incandescent lamps at $12 per lamp per year. Mr. Swann expects to be ready to furnish electrical service in Bristol by April 1, 1911, and has placed several contracts to furnish

electrical service in this city. It is understood that the proposed plant will involve an expenditure of about $500,000.

KINGSPORT, TENN.—The Equitable Securities Company, which awarded a contract for crushing and cement machinery for its new plant to the Allis-Chalmers Company, of Milwaukee, Wis., has recently placed a contract with the same company for the necessary motors to drive the machinery, which include induction motors, varying in sizes from 20 hp to 150 hp, and six 100-kva, oil-filled, self-cooled transformers.

SHELBYVILLE, TENN.—The Bedford Light & Power Company is contemplating extending its service to Wartrace, a distance of eight miles, and expects to have its system in operation by June 15. The company proposes to extend its lines to one or two additional towns, to supply electricity for lamps and motors, and also contemplates an increase in capital stock. J. F. Boyd is president of the company.

COTULLA, TEX.—It is reported that the city is prepared to grant a franchise for the installation of an electric light plant and water works system in Cotulla. For further information address C. F. Binkley, Mayor.

DALHART, TEX.—The Dalhart Telephone Company, recently incorporated with a capital stock of $35,000, will take over the holdings of the Morris Telephone Company, operating in Dallam and adjoining counties. It also proposes to install a telephone system in Dalhart, Channing, Dumas, Corlena and Stratford, Tex., and improve toll lines from Amarillo to Dalhart and to Texhoma and erect a long-distance line from Dalhart to Ochiltree. W. B. Slaughter, D. B. Bill and others are interested in the company.

FORT WORTH, TEX.—It is reported that contracts will be awarded about May 15 by the Fort Worth, Mineral Wells & Western Railroad Company for the construction of its proposed railroad, extending from Fort Worth to Mineral Wells, a distance of 60 miles. Both steam and electricity will be used as motive power. J. S. Hanford, of Beaumont, Tex., is president.

GROVETON, TEX.—Negotiations have been closed whereby J. P. Starnes, president of the Lufkin Electric Light & Power Company, of Lufkin, Tex., will take over the plant and holdings of the Groveton Light & Ice Company, of Groveton. Mr. Starnes will act as president and manager of the local company.

HOUSTON, TEX.—The Houston & Bay Shore Traction Company, recently organized, is reported to be preparing plans for the construction of an electric interurban railway between Houston and a number of resorts on the Galveston Bay, including La Porte and Seabrook.

HOUSTON, TEX.—Preparations are being made by a syndicate of Michigan capitalists for the construction of an electric interurban railway between Houston and La Porte and Morgan's Point, via Harrisburg. The proposed railway will be about 30 miles long, rights of way for which are now being secured. As yet the names of the parties interested in the project have not been made public.

LANCASTER, TEX.—The Lancaster Milling Company is reported to be considering the question of installing an electric light system and ice plant. F. H. Hammond, of Lancaster, Tex., is secretary and treasurer.

THORNDALE, TEX.—It is reported that Messrs. Ziescang & Johnson are contemplating the installation of an electric light plant in Thorndale. They already have a private plant for their own use.

WICHITA FALLS, TEX.—The plant and holdings of the Wichita Falls & Northwestern Telephone Company have been purchased by the Pioneer Telephone Company, of Oklahoma City, Okla., for $15,000.

EUREKA, UTAH.—It is reported that a large electric pump will be installed in the Centennial Eureka mine in Eureka.

MANTI, UTAH.—Negotiations have been closed whereby the City Council has purchased the plant and holdings of the Manti Light & Power Company for $17,500. The city recently voted to issue $25,000 in bonds for an electric plant, which will leave $7,500 for improvements and extensions to the plant. The plant will be taken over by the city May 1, 1910.

BEDFORD CITY, VA.—Announcement has been made that the $100,000 in bonds, recently voted by the town, have been disposed of and work will commence as soon as possible on the construction of the hydroelectric power plant to be erected by the municipality on the James River, at Snowden. The initial installation will develop 1000 hp and will be increased as the occasion demands.

GRAHAM, VA.—A project is under way to organize a company to furnish the city with water and electricity for lighting in Graham. It is understood that the company proposes to purchase the municipal water works system. R. B. Williams, J. F. Dudley and others are interested in the enterprise.

RICHMOND, VA.—The light committee of the City Council has authorized the superintendent of the Light Department to contract with the Virginia Railway & Power Company for an extension of the present street-lighting contract, as the new municipal electric light plant will not be ready for service for at least four months. The company has offered to supply street lamps on a basis of $54.75 per lamp per year for any fractional part of a year.

ROANOKE, VA.—J. C. Nesbit & Company, of Roanoke, Va., is reported to have secured the contract for the construction of the power house in connection with the machine shops for the Norfolk & Western Railway Company.

ROANOKE, VA.—The contract for the construction of the Mill Mountain Incline Railway, up Mill Mountain, is reported to have been awarded to C. Markley, of Roanoke, Va. The Lidgerwood Manufacturing Company, of New York, N. Y., will furnish the machinery and equipment. Wingate & McGhee, of Roanoke, Va., are engineers.

SALTVILLE, VA.—Plans are being made by the Mathieson Alkali Works, of Saltville, Va., for the installation of a 250-hp engine-driven power unit to furnish alternating current to operate motors in and about its plant.

BELLINGHAM, WASH.—Preparations are being made by the Home Automatic Telephone Company for the erection of a telephone line between Bellingham and Seattle, Wash., at a cost of about $15,000. Earle Knight is local manager.

PORT ANGELES, WASH.—The power and light franchise recently granted by the City Council to Thomas T. Aldwell is reported to have been assigned to the Olympic Power & Electric Company, which will commence work at once on the construction of a power plant on the Elwha River.

SEATTLE, WASH.—It is understood that a meeting of the stockholders of the Pacific Coast Power Company will be held in Seattle to vote on the proposition to increase the capital stock of the company from $7,000,000 to $10,000,000, the proceeds to be used for the development of the White River project, by which the waters of the river impounded in Lake Tapps will be utilized to develop 30,000 hp, which will be used to operate electric and interurban railways systems and for manufacturing purposes in Seattle, Tacoma, Bellingham and Everett. The initial development will require an expenditure of about $2,250,000. The work will be done by the Stone & Webster Engineering Corporation, of Boston, Mass.

SPOKANE, WASH.—The contract for transformers for the City Light Department is reported to have been awarded to the Fort Wayne Electric Works, Fort Wayne, Ind., for $20,653.

TACOMA, WASH.—Plans are being considered by Rhodes Brothers for the installation of a 250-kw electric power plant for their department store.

WINLOCK, WASH.—A large power plant will be installed by the J. A. Veness Lumber Company during the coming summer, the equipment of which will include a steam turbine generating unit of from 300 to 400 kw, exciter units, switchboard, condenser, pumps and large alternating-current motors.

BERWIND, W. VA.—The New River & Pocahontas Consolidated Coal Company is reported to be contemplating the installation of electric motors to operate the machinery in and around its collieries.

NEW MARTINSVILLE, W. VA.—The stockholders of the new Martinsville Heat & Power Company have authorized an expenditure of $10,000 for the installation of gas engines to replace the steam engines now in the plant. When the improvements are completed a 24-hour service will be established.

CHIPPEWA FALLS, WIS.—The Davis Falls Land Company, of Davis (formerly Jim Falls), has awarded the contract for the construction of its dam at Davis, on the Chippewa River, to Ule & Company, of Grand Rapids. The cost of the work is estimated at about $70,000.

EDGERTON, WIS.—The Edgerton Wagon Company, recently incorporated, is reported to have decided to erect a new plant, 50 ft. x 100 ft., which will probably be equipped for electric motor drive.

JEFFERSON, WIS.—Bonds to the amount of $10,000 have been voted, the proceeds to be used to purchase the remainder of the local water power.

MOSINEE, WIS.—The Wausau Street Railway Company, of Wausau, Wis., is reported to have purchased a site for the construction of a power plant to develop 7000 hp.

OCONOMOWOC, WIS.—The Milwaukee Light, Heat & Traction Company, of Milwaukee, Wis., has been granted a franchise by the Common Council to construct and operate an electric railway in Oconomowoc. The proposed railway will be an extension of its system from Milwaukee.

WEST ALLIS, WIS.—The new machine shop of the Kearney & Trecker Company at West Allis, it is said, will be equipped for electric motor drive.

VERMILION, ALTA., CAN.—A committee consisting of E. Tomkin and R. A. Wilson has been appointed to look into the question of erecting a telephone system in Vermilion.

WELLINGTON, B. C., CAN.—The British Columbia Copper Company is contemplating the construction of an aerial tramway to connect its Lone Star mines with its Wellington property. The proposed tramway will be about seven miles in length. Newman Erb is president of the company.

BRANDON, MAN., CAN.—The City Council is considering the proposition submitted by the Great Falls Power Company, to deliver not less than 2500 hp at the switchboard for $26 per hp per year. Charles Chamberlain, of Winnipeg, Man., Can., is representing the Great Falls Power Company.

MINNEDOSA, MAN., CAN.—It is reported that the town officials are considering the question of calling tenders for the construction of a hydroelectric power plant.

WINNIPEG, MAN., CAN.—Bids will be received until May 16 by chairman of the Board of Control for installation of an electrical distributing system as follows: No. 51—Conduit. No. 52—Construction conduit. No. 53—Substation transformers and switching apparatus.

Copies of plans and forms of tenders may be obtained from the office of the power engineer, Carnegie Library, William Avenue, Winnipeg, Man. Bids will also be received until May 3 at the same office for a straight-line belt-driven air-compressor complete, with a full set of sight feed oil cups, having a capacity of at least 250 ft. per minute, compressed to a pressure of 100 lb. to the square in., to be delivered f. o. b. cars, city quarry, Stoney Mountain.

OTTAWA, ONT., CAN.—The bill to incorporate the St. Lawrence Power Transmission Company has been passed by the House of Commons.

QUEENSTON, ONT., CAN.—H. H. Collier, representing the Niagara & St. Catharines Railway, has applied to the City Council for a franchise for an electric railway in Queenston. The company proposes to construct a railway between St. Catharines and Niagara-on-the-Lake.

QUEBEC, QUE., CAN.—Contract will soon be placed by the Quebec Railway, Light & Power Company for the construction of its extension to Sillery Hill, consisting of 2½ miles of double track. C. E. A. Carr, of Quebec, is general manager.

MOOSE JAW, SASK., CAN.—The report that the Canadian Pacific Railway Company will equip the Crow's Nest Pass Railway to be operated by electricity is revived again by the incorporation of a company capitalized at $1,000,000 for the purpose of developing the water power of the Pend d'Oreille River, at its junction with the Salmon River. It is believed that the Canadian Pacific Railway is behind the new company.

GUADALAJARA, JALISCO, MEX.—Plans are being considered by Manuel R. Unruchurto for the construction of a hydroelectric power plant on the Tequile River, in this State. He has already applied to the Federal Government for a concession for the proposed project.

ALVARADO, VERA CRUZ, MEX.—The City Council is reported to have awarded a contract to Lara & Leal, of Mexico City, Mex., for the installation of an electric light plant in Alvarado.

New Industrial Companies.

THE ÆTNA ENGINEERING & CONTRACTING COMPANY, of Herkimer, N. Y., has been incorporated by C T. Ford, of Central Valley, N. Y.; H. A. Van Alstyne, E. B. Baker, Schenectady, N. Y., and C. C. Tegethoff, of Brooklyn, N. Y. The company is capitalized at $50,000 and proposes to do a general engineering and contracting business.

THE AMERICAN RAILWAY & STREET CAR INDICATOR COMPANY, of New York, N. Y., has been incorporated by O. L. Egloff, H. W. Weir and W. Wenderhold, of New York, N. Y. The company is capitalized at $200,000, and proposes to manufacture and deal in railway and street car indicators.

THE ANTHONY SALES COMPANY, of New York, N. Y., has been incorporated with a capital stock of $350,000 by N. W. Anthony, A. R. Anthony and D. C. Munson, of New York, N. Y. The company proposes to do a mechanical and electrical engineering business; also boiler makers, brass founders, etc.

THE BAYONNE STEEL CASTING COMPANY, of West Orange, N. J., has filed articles of incorporation, with a capital stock of $150,000. The company proposes to manufacture and install mechanical, electrical, signalling and safety railroad appliances. The incorporators are: W. D. Sargent, of West Orange, N. J.; G. M. Judd, E. H. Fallows, of New York, N. Y.

THE BRADLEY RUST-PROOFING COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $100,000 by W. A. Watson, J. J. Bradley, J. F. Fausch, of Brooklyn, N. Y., and M. E. Harby, of Huntington, N. Y. The company render metals and metal goods rust proof and deal in same.

THE COLONIAL ILLUMINATING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $150,000 to manufacture and deal in electric lamps and machinery. The incorporators are: E. M. Jerome, W. B. Fiske and R. C. Finch, all of New York, N. Y.

THE CONSOLIDATED ELECTRIC COMPANY, of Kittery, Maine, has been incorporated with a capital stock of $10,000 for the purpose of dealing in electric lamps and appliances. H. Mitchel, of Kittery, Maine, is president; S. J. Morrison, of Portsmouth, N. H., treasurer.

THE DUNN DOME & FIXTURE COMPANY, of New York, N. Y., has been chartered with a capital stock of $25,000 to deal in gas and electric fixtures. The incorporators are: J. A. Campbell, of Brooklyn, N. Y.; E. M. Cavanaugh, of Passaic, N. J., and H. F. Snyder, of Elizabeth, N. J.

THE GEORGE A. DUGAN COMPANY, of New York, N. Y., has been chartered with a capital stock of $5,000 to do a general contracting and construction business by George A. Dugan, A. W. Dugan and George F. Baech, all of 160 Fifth Avenue, New York, N. Y.

THE GREAT LAKES ELECTRIC WELDING COMPANY, of Borough of Queens, N. Y., has been incorporated with a capital stock of $5,000 by Alexander R. Boyce, William Rasquin, Jr., both of Flushing, N. Y., and Lance Nicholson, of Buffalo, N. Y., as electrical and mechanical engineers, tool-makers, machinists, metal workers, founders, etc.

THE HAMLER-EDDY SMOKER RECORDER COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $15,000 to manufacture a smoke recorder for use in power plants, which was exhibited at the Chicago electrical show last January. The incorporators are: E. W. Pottle, Arthur L. Ballas and George J. Meier.

THE KRAUSS CHANDELIER WORKS COMPANY, of Newark, N. J., has been chartered with a capital stock of $25,000 by C. V. D. Smith, H. Thevenet and A. Krauss, of Newark, N. J. The company proposes to manufacture gas and electric fixtures, brackets, chandeliers, etc.

THE MYERS GAS GENERATOR COMPANY, of Buffalo, N. Y., has been incorporated by C. B. Myers, P. L. Marvin and J. H. Schumacher, of Buffalo, N. Y. The company is capitalized at $3,000,000 and proposes to manufacture and deal in machinery operated by gas, etc., and also to deal in all kinds of gas machinery and fixtures.

THE PIPE & BOILER COVERING COMPANY, of Elizabeth, N. J., has been incorporated with a capital stock of $50,000 by A. B. Metzger, S. X. Metzger and M. A. Metzger, all of Newark, N. J. The company proposes to manufacture coverings for pipes, boilers, etc.

THE PROTECTIVE MANUFACTURING & SALES COMPANY, of New York, N. Y., has been chartered by C. E. Terrell, C. A. Tilly, Brooklyn, N. Y., and H. Smith, of Union Course. The company is capitalized at $50,000 and proposes to manufacture and deal in motors, engines, automobiles, carriages and supplies for same.

THE SANTANONI CONTRACTING COMPANY, of Newcomb, N. Y., has been chartered with a capital stock of $25,000 by J. Anderson, Jr., of Newcomb, N. Y.; G. N. Ostrander, of Albany, N. Y., and P. Tummins, of Newcomb, N. Y.

THE STRICKLAND VACUUM CLEANING MACHINE COMPANY, of New York, N. Y., has been incorporated by E. S. Strickland, J. H. Weber and J. F. Pitz, all of New York, N. Y. The company is capitalized at $50,000 and proposes to manufacture and deal in vacuum cleaning machinery and tools.

THE STROMBERG ELECTRIC COMPANY, of Chicago, Ill., has been chartered with a capital stock of $200,000 by K. B. Miller, J. B. Edwards and H. G. Rockwell, of Chicago, Ill. The company proposes to manufacture time-recording devices.

THE THOMPSON-MOELLER IGNITION SYSTEM COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $1,000 to manufacture and deal in ignition apparatus for gas engines, etc. The incorporators are: Oliver B. Thompson and Carl R. Moeller, all of Buffalo, N. Y.

THE TRIGGS SMOKE PREVENTION & FUEL SAVINGS COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $100,000. The incorporators are: C. E. Triggs, W. F. Lewis and A. E. Sanborn, of Wilmington, Del.

THE TROY ROLLER BEARING COMPANY, of Troy, N. Y., has been incorporated with a capital stock of $150,000 to manufacture and deal in roller bearings, journals, etc., machine supplies and appliances. The incorporators are: J. B. Dingham, W. J. Brewer and P. J. Smith, of Troy, N. Y.

THE WESTERN CARBON & BATTERY COMPANY, of Seattle, Wash., has been incorporated by John F. Gorman, E. H. Stolten and James A. Gorman, American Bank Building, Seattle, Wash.

THE WROUGHT IRON & ART GAS FIXTURES COMPANY, of New York, N. Y., has been chartered with a capital stock of $6,000 by Max Zuckerman, Benjamin Leibovitz, both of Brooklyn, N. Y., and Oscar Bauman, 37 West 117th Street, New York, N. Y. The company proposes to manufacture and deal in gas and electric fixtures, etc.

New Incorporations.

COLORADO SPRINGS, COL.—Articles of incorporation have been filed for the Empire Water & Power Company by William A. Otis, K. R. Babbitt and C. E. Titus. The company is capitalized at $1,000,000 and proposes to supply electricity for lamps and motors and water to towns, cities and manufacturing establishments, chiefly in El Paso and Teller counties.

ATHENS, GA.—The Athens Railway & Electric Company has been chartered with a capital stock of $1,050,000 by John R. White, of Whitehall, Ga.; J. Y. Carithers, W. S. Holman, A. H. Hodgson, C. D. Flanigan, James White and W. T. Bryan, of Athens, Ga.

BLUFFS, ILL.—Articles of incorporation have been filed for the Bluffs Electric Light, Power & Heating Company by Fred D. Brockhouse, John D. Brockhouse and F. C. Funk. The company is capitalized at $5,000 and proposes to operate electric light, power, steam, refrigerating and other plants.

BUFFALO, ILL.—Articles of incorporation have been filed for the Central Illinois Electric Company by J. E. McCann, C. M. Kimball and George B. Conover, of Buffalo, Ill. The company is capitalized at $2,500 and proposes to operate a heat, light and power plant.

CORNELL, ILL.—The Cornell Electric Light & Power Company has been chartered with a capital stock of $5,000 by F. H. Rucker, A. R. Gourley and William Brunskill.

HULL, ILL.—The Hull Milling, Light & Canning Company has been incorporated with a capital stock of $10,000 to operate a mill, electric light and canning factory. George L. Lay, A. L. Maples and J. W. Kuhlman, of Hull, Ill., are incorporators.

MARION, ILL.—The Marion Railway Company has been incorporated

with a capital stock of $10,000 to operate a railway from Marion to Johnson City, Ill. The incorporators are: A. E. Harper, William D. Haynie, E. J. Hughes and William H. Wardner, of Marion, Ill.

BROWNSTOWN, IND.—The Brownstown Water & Light Company has been incorporated with a capital stock of $50,000. The directors are Harley Jackson, D. B. Vancet and G. S. Gray.

PORTLAND, MAINE.—Articles of incorporation have been filed for the Consumers' Power Company with a capital stock of $20,000,000. The company proposes to generate, transmit and supply electricity for lamps, heating and other purposes. The incorporators are: James R. Parsons, William M. Bradley and A. G. McPherson, all of Portland, Me.

BUFFALO, N. Y.—The Conant-Bryant Power Company has been incorporated with a capital stock of $25,000 by Russell W. Bryant, John B. Richards and George R. Klahs, of Buffalo, N. Y. The company proposes to generate and sell electricity for lamps, motors and heat.

NEW YORK, N. Y.—The City & Suburban Railway Company has been incorporated with a capital stock of $230,000 to operate an electric railway from the Ridgewood reservoir in Brooklyn to Amityville, a distance of 23 miles. The directors are: William H. Borroughs, I. T. Flatto, L. C. Neuberger and David H. Cagney, of New York, N. Y.

PORTSMOUTH, R. I.—The Portsmouth Electric Light Company has been chartered with a capital stock of $100,000. The incorporators are: Henry C. Anthony, of Portsmouth, R. I., president; David R. Lawton, of Tiverton, secretary; John L. Borden, of Portsmouth, R. I., and George R. Lawton, of Tiverton, R. I.

YANKTON, S. D.—The Iowa & Dakota Interurban Railway Company has been incorporated to construct an interurban railway from Sioux City, Ia., to Mitchell, S. D., 125 miles in length. The company is capitalized at $500,000, and the directors are: B. E. Wells, E. E. Banford and H. F. Valentine, of Centerville, S. D.; C. L. Phillips and W. G. Amundson, of Lake Andes, S. D.

BURRISTOWN, TENN.—The Burristown Home Telephone Company has been incorporated with a capital stock of $2,000 by J. P. Warren, W. F. Carwile, C. T. Masters, J. P. Cox and others.

HARRIMAN, TENN.—Articles of incorporation have been filed for the Tri-County Telephone & Telegraph Company, with a capital stock of $10,000. The company proposes to construct and operate a telephone line from Oliver Springs to points in Roane, Anderson, Knox, Loudon, Cumberland, Scott, Morgan, Campbell and adjoining counties.

HUMBLE, TEX.—The Humble Water, Light & Ice Company has been incorporated with a capital stock of $12,000 by Charles S. Polk, E. L. Cullum and W. E. Sholar.

TEMPLE, TEX.—The Temple Northwest Railway Company has been incorporated with a capital stock of $100,000 by George E. Wilcox, A. F. Bentley, John A. Cole, P. L. Downs, H. W. Peck, J. W. Beard and D. J. G. Gribbsby. The company proposes to construct an electric railway from Temple to Comanche, a distance of 100 miles.

SEATTLE, WASH.—The Berlin Power Company has been chartered with a capital stock of $500,000 by R. C. Burtrand, F. L. Forbes, James H. Henley and W. H. Bruckart.

SPOKANE, WASH.—Articles of incorporation have been filed for the Boulevard Park Railway Company by Samuel Glasgow and others. The company is capitalized at $12,000.

Personal.

MR. WILLIAM A. HILLEBRAND, instructor of electrical engineering at Stanford University, has been promoted to an assistant professorship in the department.

MR. V. R. LANSINGH gave an address on April 20 before the Technology Club, of Syracuse, N. Y., entitled "Investigations of Fundamental Requirements of Street Lighting."

MR. GLENN MARSTON delivered a lecture last week before the Adelphi College of Brooklyn on the subject of public service utilities here and abroad, with a comparison between European and American methods.

MR. ARTHUR W. BALLARD, who for the past 20 years has been connected with the General Electric Company and is now manager of the company's Los Angeles office, has resigned his position, to take effect on May 1.

DR. W. H. TOLMAN, director of the American Museum of Safety, has been selected by the National Electric Light Association to make a special study of the German system of governmental insurance in regard to sickness, accident and invalidity.

MR. W. N. KEISER, electrical engineer Des Moines Electric Company, leaves that company May 1 to go with the Union Electric Company of Dubuque, Ia. With the Dubuque company he will work mainly along lines of promoting and retaining business.

MR. PHILIP HAMBURGER, JR., has withdrawn as secretary and treasurer of the Joseph M. Zamoiski Company, of Baltimore. His interest in the large electrical establishment, which is located on North Liberty Street, has been purchased by Mr. Joseph M. Zamoiski.

MR. CHESTER C. WYMAN has resigned as chief electrician with the Indianapolis & Louisville Traction Company to become general manager of the Scott County, Ind., Telephone Company. Mr. Leslie A. Andis succeeds Mr. Wyman as chief electrician of the traction company.

MR. S. FRED. SMITH, the retiring president of the New England Section of the National Electric Light Association, has been elected to represent the Section on a joint committee which is considering ways and means for the erection of an Engineers' Building in Boston, which will be the home of the numerous engineering societies and branches in that city.

MR. JUSTUS ECK, M. I. E. E., Secretary of the Union Electric Company, Ltd., London, the British representative of the Excello lamp, is making a short visit to the Excello Arc Lamp Company, New York. Mr. Eck, accompanied by Mr. H. M. Hirschberg, president of the latter company, left on a two weeks' trip through the West last Sunday. Mr. Eck will return to London on the S. S. *Carmania,* May 14.

MR. NORMAN B. HICKOX, manager of "new business" for the S. S. Bush Properties, located at DeKalb and Sycamore, Ill.; Rome, Ga.; Jackson, Tenn.; Vincennes, Ind., and Scranton, Miss., has resigned his position, to take effect May 1, when he will go with Mr. E. L. Callahan, manager of "new business" for the H. M. Byllesby Company and locate at Muskogee, Okla. Mr. Hickox left the General Electric Company in 1908 to accept the position he is just leaving.

MR. SAMUEL L. CURWEN has been elected president of the Wason Car Company, of Springfield, Mass. Mr. Curwen has been connected with the J. G. Brill Company, of Philadelphia, since boyhood, of which company he is now vice-president and general manager. He is also president of the G. C. Kuhlman Car Company, of Cleveland; the American Car Company, of St. Louis; the Danville Car Company, of Danville, Ill., and vice-president of the John Stephenson Car Company, of Elizabeth, N. J.

DR. C. F. CHANDLER will be the guest of honor at a banquet to be held at the Waldorf-Astoria on April 30, under the auspices of the American Electrochemical Society, the Chemists' Club, the Society of Chemical Industry, the American Chemical Society, the American Institute of Chemical Engineers and the Verein Deutscher Chemiker, on the occasion of his retirement as head of the department of chemistry of Columbia University.

MR. F. M. DENTON, of the faculty of the Carnegie Technical Schools, has been appointed associate head of the department of Electrical Engineering and Applied Physics at the Northampton Polytechnic Institute, London, England, this position having been rendered vacant by the resignation of Dr. C. V. Drysdale, who had been on the staff of the institute since its opening in 1896. Mr. Denton received his technical education at the Central Technical College of the City and Guilds of London Institute and subsequently was employed at the instrument-making works of Messrs. Elliott Bros., London, and at the works of the Massachusetts Oerlikon, Switzerland. After a year on the staff of the Electrical Engineering Department of the Central Technical College he joined the engineering force of the Stanley-G. I. Electric and Mfg. Co., at Pittsfield, Mass., and was transferred to the General Electric Company's works, at Schenectady. Two and a half years ago he was appointed instructor in electrical engineering at the Carnegie Technical Schools, Pittsburgh, Pa., a position which he is resigning to take up his London appointment.

Obituary.

MR. G. J. FRANKEL.—Mr. George J. Frankel, Superintendent of the Western Union Telegraph Company, died at San Antonio, Tex., April 19.

MR. CHARLES J. OSBORN, who was manager of the O'Reilly Telegraph Company, with offices in Chicago, from 1851 to 1853, died at St. Louis on April 18. For 55 years Mr. Osborn was correspondent and otherwise affiliated with the Associated Press in St. Louis, and in the Associated Press organization itself he was generally known as the dean among the correspondents. Mr. Osborn was born in Utica, N. Y., and was 84 years of age at the time of his death. He learned telegraphy in Pittsburgh in 1847.

MR. J. OLDHAM.—Mr. John Oldham, founder of the Western and River Plate Telegraph companies, died in Buenos Ayres, Argentine, April 19. He was born in England and was for many years connected with the British posts and telegraph service, also with the W. T. Henley Telegraph Cable Works in London. Mr. Oldham laid the first wire connecting Uruguay with Buenos Ayres, and did much to advance the prosperity of Uruguay. For his skill in telegraphic science he was decorated with the insignia of the Chevalier of the Order of the Rose by Dom Pedro of Brazil.

MR. JOHN HENRY MILLER, one of the promoters of the Belt Line Railroad, the electric freight line of Baltimore, Md., and also one of the promoters of the project of using the power of the Susquehanna River to obtain electricity, died in Baltimore from heart trouble on April 24. Mr. Miller was born at Fort Monroe in 1843, and after being educated at Morgantown Academy went to Pittsburgh, where he started a successful boom in building telegraph lines throughout the West. He went to Baltimore in 1888, where he interested the Baltimore & Ohio Railroad in the belt line which now serves that city. With several other business men he foresaw the possibilities of making the water power of the Susquehanna River generate electricity, and when the Susquehanna Electric Power Company was incorporated Mr. Miller was elected secretary. A widow, daughter and two sons survive him.

MR. GEORGE GRIFFITHS STEEL, publicity manager of the Bell Telephone Company of Pennsylvania and managing editor of *The Telephone News,* Philadelphia, died at Pittsburg, April 11, of pneumonia, after a short illness. Mr. Steel was born in 1876 and had been connected with the Philadelphia office of the company for eleven years. Under his care *The Telephone News* grew from a department sheet to a well-edited telephone newspaper of interest and value far beyond the circle of companies and employes immediately served. He also had a rare talent for publicity work in general, his designs of newspaper advertisements being models of convincing argument united with good taste.

CHRISTIAN JENSEN TOERRING died in Philadelphia, April 22, after a prolonged illness following an operation for appendicitis. Mr. Toerring, though a young man, was one of the pioneers in perfecting the enclosed arc lamp for practical lighting. Born in Denmark, 39 years ago he came to this country as a child, and was educated in the universities of Illinois and Cornell, graduating from Cornell in 1893. He began the manufacture of arc lamps in Philadelphia in 1899, developing them to a degree of perfection which placed his lamps in a class by themselves. He was a member of the Franklin Institute, of the American Institute of Electrical Engineers, and of the Illuminating Engineering Society.

MR. EMORY COBB, a capitalist and prominent citizen of Kankakee, Ill., died on April 15 as the result of a kick from a horse. Mr. Cobb was interested in electrical pursuits a number of years ago. He was a pioneer telegrapher, and in 1852 he was transferred from the Cleveland office of the Erie & Michigan Telegraph Company, of which he was manager, to the Chicago office, bringing with him Mr. Marvin Hughitt, now president of the Chicago & Northwestern Railway Company, who was the first chief operator in the Chicago telegraph service. Mr. Cobb is said to have originated the system of transferring money by telegraph, and he is also given the credit for laying the first subaqueous telegraph cable in the United States, connecting Detroit and Windsor, Ont. He retired from the telegraph service in 1865 and removed to Kankakee the following year. He was very successful in business. In 1891 Mr. Cobb, with his sons, put into operation the pioneer electric railway in Kankakee, which was one of the early electric street-railway lines of Illinois.

Trade Publications.

PREVENTING LINE TROUBLES.—The Delta Star Electric Co., Chicago, Ill., is distributing a 20-page folder descriptive of a new protective system for use on series lighting systems. The function of this new device is to cut out automatically a defective loop of the lighting systems and at the same time keep in operation those parts of the system which are operative. Several diagrammatic drawings illustrate the application of this protective feature to commercial street lighting systems.

WATT-HOUR METERS WITH PREPAYMENT ATTACHMENTS.—In Bulletin No. 4716, published by the General Electric Company, are described several types of prepayment watt-hour meters, which are claimed to form a practical solution of the problem of producing a satisfactory prepayment meter. These meters are arranged for use with either a separate or combined prepayment device, and are made for two and three-wire service, and 100 to 120, or 200 to 240 volts, direct or alternating current. This publication contains dimensions of the meters, and diagrams of connection.

EXHAUST STEAM HEATING.—"A Problem in Piping and Fifteen Solutions" is the title of a 16-page, 6 x 9-in. pamphlet, issued by the Harrison Safety Boiler Works, Philadelphia, Pa. The problem was originally published in this company's advertisements in several of the technical papers, and the solutions here presented have been selected from those submitted by readers of the advertisements. The problem set is how best to connect up an exhaust steam heating plant in which there are two exhaust mains, one from the main engine, and one from the pumps, an open feed-water heater and receiver, and a riser to the heating system, the piping to be so arranged that the heating system shall at all times receive steam that has been purified of oil, and so that the exhaust of both pumps and engines shall be available for the feed-water heater or for the heating system, as required. Provision was also to be made for cutting the heater out of service for cleaning or inspection without interrupting the supply of purified exhaust to the heating system. While many of the solutions presented are ingenious, and some of them neat and practicable, most are defective in that it would be possible to subject the heater to high presure steam or stall the engine, and all of them involve the use of an independent separator and trap, together with valves and other fittings, all of which, it is claimed, can better be replaced by the new Cochrane Steam-Stack and Cut-Out Valve Heater and Receiver. The new and peculiar feature of this heater is that it has attached to and forming a part of it an oil separator of sufficient capacity to purify all of the exhaust steam available, including that which goes to the heating system. It is also provided with valves for cutting the heater body out of circuit while the separator remains in service. The pamphlet will be of interest to all who are concerned with the design, installation or operation of exhaust steam-heating systems.

BUSINESS NOTES.

THE ALBERGER CONDENSER COMPANY AND ALBERGER PUMP COMPANY have moved their offices to the West Street Building, 140 Cedar Street, New York City.

HEANY NEW YORK OFFICES.—On and after May 1 the New York offices of the Heany Company, Heany Lamp Company and Heany Fireproof Wire Company will be located at 1753 Broadway, corner of Fifty-fifth Street.

RAY D. LILLIBRIDGE, Incorporated, the advertising firm, has moved its New York office from 100 Broadway to 192 Broadway, where it will occupy the tower suite in the Chatham National Bank Building. The firm will combine with its general office the branch which has been maintained for the past eight years at 79 Nassau Street.

THE NATIONAL-ACME MANUFACTURING CO., Cleveland, O., has opened an office at Detroit in charge of Mr. E. G. Matter, who has been with the company for about five years in the Ohio and Chicago territories. Mr. Matter's office is located at Majestic Bldg., and he will serve the territory in and around Detroit, Eastern Michigan and Northwestern Ohio.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 19, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

595,126. ELECTRICAL DISTRIBUTING BOARD; H. J. Blakeslee, Utica, N. Y. App. filed June 5, 1907. An insulating base with apertures and a busbar on one face and circuit terminals on the opposite side and a plug in the aperture, making electrical connection through a fuse.

955,134. SELECTIVE LOCKING KEY; J. F. Cadell, Baltimore, Md. App. filed May 20, 1907. For telephone circuits in which a series of spring-actuated plungers reciprocate in a frame, a cam with a flat back is provided for each plunger and contacts are closed thereby with means for locking the plunger in a depressed position.

955,137. CONTROLLER FOR ELECTRIC MOTORS; W. M. Connelly, Chicago, Ill. App. filed Jan. 26, 1909. Hand controller in which the arc is formed at the contacts of magnetically controlled switches governed by a hand switch.

955,141. ANTI-INDUCTION DEVICE; M. M. Davis, New York, N. Y. App. filed July 14, 1909. An anti-inductive arrangement of conductors in inductive relation to a conductor carrying disturbing impulses, consisting of an insulated conductor in circuit with a signaling instrument with parallel idle conductor and means for varying the resistance and capacity of the idle conductor, so that it reacts on the signal conductor by induced currents to an equal and opposite extent as the disturbing conductor.

955,142. DEVICE FOR PREVENTING INDUCTION IN ELECTRICAL CONDUCTORS; M. M. Davis, New York, N. Y. App. filed July 17, 1909. A compensating conductor is caused to react on the circuit conductor, which reacts and is graduated to neutralize the action of the disturbing source on the signaling conductor.

955,154. SWITCH USED WITH ELECTRIC MOTORS; H. C. Grant, Bayonne, N. J. App. filed June 6, 1908. Switch for electric motor, including a lever carrying the bushing, which carries conducting segments surrounded by an insulating ring. A plurality of sheet-metal contacts are fastened to the ring and rest against the segment.

955,171. EXCITING ALTERNATOR; C. H. Kicklighter, Newberry, S. C. App. filed Nov. 9, 1908. Self-exciting alternator, with direct-current fields and polyphase armature, a converter with distributed windings supplying the armature, commutator brushes, the converter being a unit with the alternator.

955,185. HANGER FOR TROLLEY WIRES; W. A. McCallum, Cincinnati, Ohio. App. filed May 24, 1909. An integral shield with a socket and a screw-threaded suspending bolt projecting below the socket and screwed to the trolley car.

955,190. ATTACHMENT FOR TELEPHONES; J. W. Nilsson, Balfour, N. D. App. filed May 8, 1909. For party line with an audible signal controlled by the telephone switch and a gear-driven governor for regulating the speed of the signal which indicates to the user the presence of an auditor at another telephone.

955,192. ELECTRIC SIGNALING DEVICE FOR MOTOR CARS; J. L. Palous, Berlin, Germany. App. filed April 13, 1908. Electric horn for motor cars operated by an electric magnet which controls a circuit interrupter and is arranged near a diaphragm.

955,251. HARMONIC SELECTIVE RINGING SYSTEM FOR PARTY LINES; H. D. Currier, Bloomfield, N. J. App. filed May 5, 1909. Selective signaling system tuned to currents of definite frequency, including a bell responding to one polarity connected with a line at each of two stations so as to be normally operative, the bells being reversely connected.

955,263. SWITCHBOARD CONSTRUCTION; T. A. Hammond, Passaic, N. J. App. filed Aug. 5, 1904. A jack for switchboards, including a pair of springs in contact normally, one secured to the rear and the other to the front of the board, the former being engaged by the plug before the latter.

955,268. ELECTRIC MACHINE; G. O. Holmgrem, Vesteros, Sweden. App. filed Jan. 3, 1910. High-speed turbo-generator with projecting poles and ventilated rotor windings.

955,273. ELECTRICAL CONDUCTOR FOR ILLUMINATING PURPOSES; I. LADOFF, Schenectady, N. Y. App. filed Jan. 4, 1904.

Arc light electrode composed of silicon uniformly distributed with iron throughout the body.

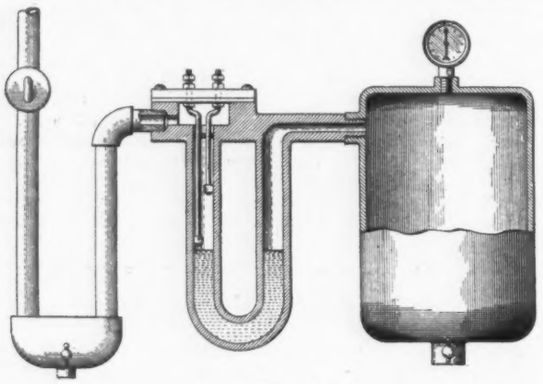
955,302. TELEPHONE SIGNAL BELL; H. L. Wuerffel, Maywood, Ill. App. filed March 26, 1909. Armature mountings for magnets consisting of a mounting plate carrying a rotatable support for the armature, a cam for adjustably supporting it with respect to the plate and a locking device.

955,323. CIRCUIT CLOSER; H. H. Cutler, Milwaukee, Wis. App. filed July 2, 1904. For electrically operated pressure regulator for steam boilers. Details.

955,335. BRIDGING TELEPHONE SYSTEM; H. F. Joeckel, Clayton, Ill. App. filed July 27, 1907. A magneto bridging system with the one-line circuit so connected to a two-line circuit as to avoid interference of the signaling and talking instrument.

955,391. ELECTROMAGNETIC SWITCH-OPERATING MECHANISM; George W. Donnan, Schenectady, N. Y. App. filed Oct. 6, 1909. For switches of street railways. The magnet operates a reciprocating part held by a catch, the catch being first released by the magnet and then the switch operated.

955,402. RAILWAY SIGNALING SYSTEM; L. F. Howard, Edgewood Park, Pa. App. filed Sept. 8, 1909. Alternating-current railway in which the track is divided in block sections for signaling and in



955,323—Circuit Closer.

which a condenser and an inductance are connected in series across the breaks in the rails at the ends of each block which permits the operating motive current to flow, but stops signaling current of another frequency.

955,438. SCREW-PLUG ELECTRICAL RECEPTACLE; Frank J. Russell, Brooklyn, N. Y. App. filed Oct. 25, 1909. A side-plug contact for electrical receptacles in which the poles are widely separated consisting of crimped metal strips arranged parallel to the axis, the crimps forming screw threads to receive the screw-threaded plug.

955,447. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed Oct. 22, 1906. Two sources of alternating current operate in parallel, to furnish current to a consumption circuit, and the load is equally divided by means of a winding included in the circuit between the two generators with means for reducing the magnetic flux in the winding to zero when the load is divided in the proper proportion. When the phase changes the energy supplied to one circuit is varied.

955,448. MEANS FOR OPERATING END CELL SWITCHES; J. W. Achard, Philadelphia, Pa. App. filed March 21, 1905. The end cell switch is driven by a motor, the controller for which is actuated and locked and released at the proper time.

955,455. MEANS FOR STARTING ALTERNATING-CURRENT MOTORS; W. J. Foster, Schenectady, N. Y. App. filed Nov. 3, 1908. For operating motors at the end of a long line to avoid pulling down the line voltage at starting. Provides an additional small motor generator set with two synchronous machines of the same frequency, the motor of the set being connected to the supply circuit and the main motor first to the generator of the set and then to the supply circuit.

955,459. APPARATUS FOR TRANSMITTING AND UTILIZING ELECTRIC CURRENTS; P. C. Hewitt, New York, N. Y. App. filed April 5, 1901. An hermetically sealed chamber enclosing a gas path with a plurality of positive electrodes, a common negative electrode, each of the positive electrodes being connected with a separate source of current.

955,460. METHOD OF TRANSMITTING AND UTILIZING ELECTRIC CURRENTS; P. C. Hewitt, New York, N. Y. App. filed April 5, 1901. Produces light by polyphase currents by transmitting through the lighting medium electric currents in one direction and making use of the reluctance of a negative electrode for opposing the flow of current in another direction.

955,461. METHOD OF MANUFACTURING FILAMENTS FOR INCANDESCENT LAMPS; J. W. Howell, Newark, N. J. App. filed Aug. 13, 1904. The method of producing flash filaments by firing an untreated carbon filament to a high temperature, depositing thereon a reduced hydrocarbon coating and then refiring at a higher temperature.

955,465. SOCKET AND ATTACHING PLUG; J. E. Luther, Schenectady, N. Y. App. filed July 13, 1907. For using a branch socket, the attachment plug having a pair of clips engaging a socket with lamp contacts in the socket connected with fingers on the socket and binding screws on the fingers, the socket having a lateral opening.

955,472. COMBINED TELEPHONE AND PROTECTIVE ALARM SYSTEM; J. G. Nolen, Chicago, Ill. App. filed May 31, 1907. A telephone having a line, a central with line signal and central operator's receiver, a protected system at the subscriber's station, signal initiating devices and a buzzer in the line circuit normally short circuited and operated by the signal devices.

955,484. ELECTRIC DENTAL ENGINE; J. V. Trenaman, Newark, N. J. App. filed Jan. 8, 1908. Details in the construction of a motor-driven drill in which the parts are adjustable, mounted on a pivotal support, so that the motor may be removed from the support by disconnecting the conductors from the field and armature without disassembling the motor.

955,521. PUSH-BUTTON; D. R. Lovejoy, Irvington, N. Y. App. filed July 30, 1907. A push-button with an insulating base and grooved back, contact springs, a circuit-closing bar with a slot receiving the wire.

955,522. ELECTRIC HAMMER; C. C. Lutes, Noxen, Pa. App. filed Nov. 5, 1909. Opposed operating magnets with a hammer armature reciprocating between and a circuit breaker actuated to throw in the magnets alternately.

955,538. MASTER CLOCK; M. W. Obermiller, New York, N. Y. App. filed Aug. 24, 1909. Master clocks for controlling electrically driven auxiliary clocks by sending direct current through the auxiliary circuit for a predetermined time.

955,598. ELECTRICAL HEATER; R. Larés, St. Paul, Minn. App. filed Apr. 6, 1909. An enclosing radiator frame containing an insulated core carrying an electrical resistance with a heat-conducting liquid in contact with the resistance and a cut-out operating on excessive temperature.

955,633. TELEPHONE SYSTEM; M. S. Conner, Oakdene, Hale, England. App. filed July 1, 1908. Automatic ringing system in which the ringing current is supplied by a generator of small power with a steady load.

955,636. ELECTRIC SIGNAL BELL; H. W. Eden, Detroit, Mich. App. filed March 1, 1907. A unitary armature and bell hammer made from a single bar of metal, one end hardened and the armature end kept soft.

955,655. ELECTRIC FURNACE; E. H. Meyer and J. Morten A. Stillsen, Niagara Falls, Ontario, Canada. App. filed March 20, 1908. A furnace with a bottom electrode, an inclined top electrode and a charging passage and tapping orifice.

955,661. INSULATOR; W. E. Moore, Connellsville, Pa. App. filed Feb. 26, 1905. Petticoat insulator with attaching means extending from the top of the insulator for supporting it, a depending post carrying wire gripping lugs.

955,676. TELEGRAPH SOUNDER; G. F. Oehmen, New York, N. Y. App. filed Jan. 21, 1909. A vertical solenoid, a straight vertical core movable mounted and means carried by the core for producing signals.

955,685. TELEPHONE TRANSMITTER; G. N. Quinby, Jr., North Providence, R. I. App. filed July 24, 1909. A casing and diaphragm, an electrode casing with a stem through the diaphragm and supported in the inclined position from the diaphragm.

955,716. TELEPHONIC TRANSMITTER; P. Stragiotti, Hurley, Wis. App. filed Aug. 11, 1908. Differential transmitter or microphone, including three electrodes, a plate carrying the central electrode, the two external electrodes being rigidly connected to an axis turning on its bearing to effect adjustment of the two external electrodes with respect to the central ones.

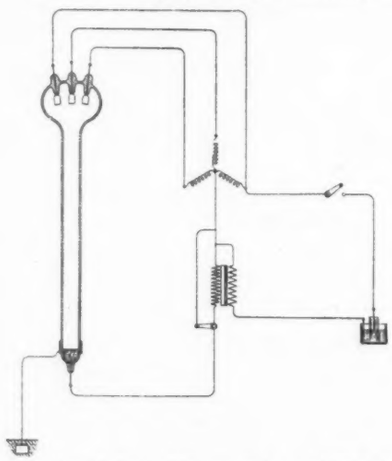
955,742. TROLLEY WHEEL REPLACER; J. W. Anderson, Hamilton, Ontario, Canada. App. filed Feb. 25, 1909. Two tapered grooved extensions projecting from each side of the trolley wheel stamped up from sheet metal.

955,747. ELECTRIC TERMINAL CLIP; W. Barey, Detroit, Mich. App. filed Nov. 8, 1909. For spark plugs for easy attachment in which the parts are indented and resiliently interlocked.

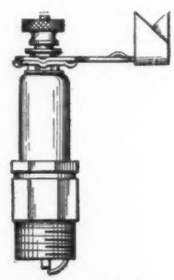
955,748. SECTIONAL INCANDESCENT LAMP; G. E. Bill and A. D. Redman, Sr., Harrisburg, Pa. App. filed Sept. 24, 1908. Lamp with a plurality of filaments, a horizontal plate across and above them, pierced by stationary tubular contacts with connecting wires between the filaments and the contacts.

955,753. ELECTRIC RAILWAY; H. C. Brown and B. A. Harris, Bloomington, Ill. App. filed Nov. 19, 1906. A third rail consisting of a conduit tiling holding a trolley wire with a contact plate above and a lug in sections secured to the wire.

955,777. SAFETY DEVICE FOR ELECTRIC LAMPS; C. W. Eisenmann, Kansas City, Mo. App. filed April 16, 1909. Tantalum lamp in which a slightly oxidized conducting wire is fused, thus short



955,460—Method of Transmitting and Utilizing Electric Currents.



955,747—Electric Terminal Clip.

circuiting a section of the multiple filament lamp when a filament breaks.

955,793. ELECTRICAL MUSCULAR EXERCISING MACHINE; W. Harris, Buffalo, N. Y. App. filed June 12, 1906. The operating cores pass over pulleys which drive an electric generator and supplies current to the body.

955,806. SUBSTATION PROTECTOR UNIT; W. Kaisling, Chicago, Ill. App. filed Dec. 11, 1905. Thermal protector, including a heat coil in series with one line, a switch held against operation by the heat coil and switching together the two lines and ground.

955,818. OZONIZER; A. Lohman, Philadelphia, Pa. App. filed Jan. 26, 1909. Plates constitute discharges with dielectric plates between.

955,820. OUTLET BOX; N. Marshall, Newton, Mass. App. filed Oct. 31, 1908. For interior conduits having a movable connecting plate for receiving the securing devices of electric fittings and means connecting said plates to simultaneous adjustment.